

THE IMPACT OF MENTAL MODELS ON MARKETING

CORE AND TECHNICAL CORE

NEW PRODUCT CHOICE

BY

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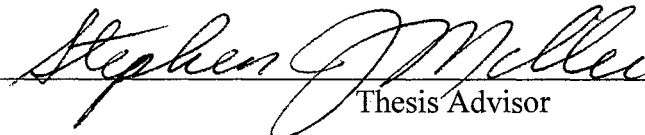
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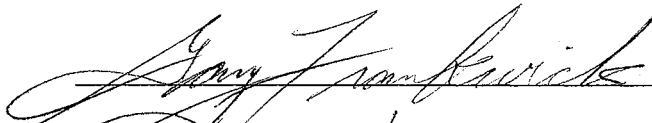
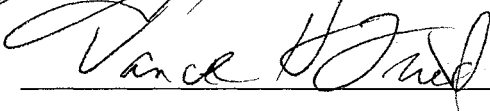
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CHAPTER I

INTRODUCTION

A number of evolving environmental factors have pushed new product development to the forefront of managerial concern as a tool for maintaining competitiveness. These factors include an increasingly turbulent environment (Howell and Higgins 1990; Lambkin and Day 1989; Miller and Friesen 1982), shortening product life cycles (Qualls, Olshavsky, and Micheals 1981), rapid technological change (Dickson and Giglierano 1986; Rosenau 1990), international competitive pressure (Dumaine 1991; Port 1990), and a large number of new products entering the marketplace. In fact, a recent Business Week cover article indicated that many economists are adopting a Schumpeterian view of economic development where innovation is seen as the driving force for economic growth (Farrell and Mandel 1994). Considerable criticism has been leveled against American firms' lack of innovative response to international pressure. While nations such as Japan stress cross training of new product personnel and have long-term innovation goals, American firms continue to produce product variates and are short term in their planning horizons (Dumaine 1991; Moenaert, Sounder, De Meyer, and Deschoolmeester 1994).

In response, American firms have sought to improve their new product development processes. Currently there is consensus that a strong interface between

marketing and research & development (R&D) leads to greater chances of new product development success (Aaby and Discenza 1993; Cooper 1984; Crawford 1991b; Drucker 1988; Gupta and Rogers 1991; Hise, O'Neal, Parasuraman, and McNeal 1990). To build upon both marketing and R&D strengths, scholars currently call for firms to adopt a "dual-drive concept of product innovation" where a firm should meld both a market driven and a technologically driven new product development approach (Aaby and Discenza 1993; Crawford 1991a; Lucas and Bush 1988; Nyström 1985).

The relationships between those engaging in marketing activities and those engaging in R&D activities are not without problems. Of the numerous barriers found to hinder the marketing-R&D interface, the most significant have been found to be lack of communication, insensitivity to others' points of view, and little trust of others' information (Gupta, Raj, and Wilemon 1985; Gupta and Rogers 1991; Gupta and Wilemon 1988; 1990; 1991; Moenaert and Souder 1990; Vesey 1991). This lack of shared vision between marketing and R&D can have an effect on the type of new product developed, new product development speed, and new product success.

Given that most new product development undertaken by companies is undertaken by new product development teams, an understanding of the issue of contention between the core new product development group members is of vital managerial concern. Souder (1988) found that disharmony between marketing and R&D was directly related to chances of new product success. For projects with severe disharmony, 68% failed. The failure rate for mild disharmony was 23% and for harmonious relationships only 13%.

Gupta and Rogers (1991) propose that under a diffusion of innovation model, marketing and R&D team members can enhance their interactions through improved communication. Without an understanding of the other constituencies' concerns, and one's own initial biases, group dynamics and the use of individual power can influence the process. This could push the new product development process too far in the direction of innovation or to minor product variations. Workman (1993) has noted that in firms dominated by a technology core (engineers), marketing functions can be taken over by non-marketers (engineers) within the firm. Closer integration of the technical core with marketing can sensitize the technical core personnel to the actual and potential needs of the customers allowing for the meeting of customer needs (Gold 1987).

Marketing, R&D, finance, production, and other personnel are different constituency groups involved in the new product development process. In order for these individuals to work effectively together, members must not only understand the other core's team members concerns, but also their own initial set of beliefs related to the new product development process (Schwenk 1988). While finance, production, and other personnel often have input into the new product development processes, this often comes after the new product idea has passed initial screening by marketing and R&D.

This study will concentrate on and extend research at the early stage of the new product development process. Specifically, this study will investigate team member's new product development mental models. Identification of those mental models can give insight to both the related antecedents and the decision outcomes of those mental models.

Differences in beliefs. It should not be surprising that members of a firm's new product development team would enter into the new product development process with differing frames of reference and differing views on how to reach organizational goals. Personal construct theory (Kelly 1955) posits that individuals develop, through education and socialization, differing schemas of the world which influence the way in which an individual anticipates and perceives events. When individuals share constructs, or have similar frames of reference, they can communicate more effectively. When individuals' new product constructs differ, communication is hindered (Gupta and Rogers 1991; Rogers and Rogers 1976).

Communication and diffusion research indicates that the degree of heterophily (or how different individuals are in their beliefs, education, and values) can influence the adoption of innovations within the firm (Gupta and Rogers 1991; Rogers and Rogers 1976). If an individual holds a set of beliefs which do not match a proposed new product innovation, that individual may be less likely to believe that the product innovation alternative will have positive outcomes for the firm and will be therefore less likely to approve the innovation. This could lead to conflicts with, and the alienation of, other team members if those team members' beliefs about that product innovation differ.

Basis for differences in beliefs. Scholars have noted that in the new product development process, at one extreme, a firm can be reactive by purposively reacting to a customer's request (Urban and Hauser 1993). This view may place emphasis on existing customers (Nyström 1985) with a belief that market demand should precede and trigger product development (Shanklin and Ryans 1987). At an extreme, this view

can lead to the rejection of innovative products and a greater reliance on product variates (Bennett and Cooper 1979; McGee and Spiro 1988; Morris and Davis 1989; Padmanabhan 1990) which in turn can lead to competitive decline (Hayes and Abernathy 1980).

At the other extreme, a firm could be proactive. A proactive firm attempts to identify customers' anticipated needs and uses technology to develop superior products before competitors can develop products to meet those expected needs (Nyström 1985; Shanklin and Ryans 1987; Urban and Hauser 1993). This could lead to the technical core seeing marketing as having the responsibility of selling the products that the technology core develops (Gupta, Raj, and Wilemon 1985a). This heavy reliance on technical prowess and lack of concern of the customer's expressed needs can lead to failure (Gupta and Rogers 1991).

It follows then that when core constituencies bring these differing mental models, and new product ideas based upon these models, into a new product development process, conflicts could arise between members with an opposing set of beliefs.

Mental Model New Product Development Belief Framework

Theories of team interaction within the firm often assume that team members can be placed into unique categories. For example, constituency theory (Anderson 1982; Day and Wensley 1983) articulates that marketing has a specific role within the firm and must attempt to negotiate with other constituency groups within the firm. The strategic plans, and therefore the tactics used to reach those plans, would be outcomes

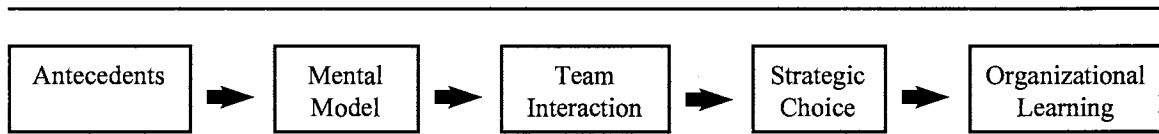
of a bargaining process. The marketing core's main goal is to satisfy the long-term needs of its customer constituency. In the early stages of the new product development process, this requires communication and negotiation between the marketing core and R&D core which would lead to firm action. In addition, much of the Marketing/R&D interface literature is based upon the premise that unique groups (marketing and R&D) can be identified within the firm.

In new product development teams, however, individuals who undertake activities may well have background, training, and experience which could differ from "traditional" role development. Indeed, their recommendations about how best to serve the needs of their firm may be more related to their mental models than to the role in which they are currently serving. Gupta, Raj, and Wilemon's (1986) R&D/Marketing interface model is based upon the sociocultural differences held between these two cores in the firm which are believed to be the result of education and socialization (personal construct theory (Kelly 1955)) and heterophily (Gupta and Rogers 1991; Rogers and Rogers 1976).

New product development team members begin their constituency negotiation from their own mental models or mental constructs. These, in turn, have been developed from the antecedents of personality, training, experience, and education. The outcome of this negotiation leads to individual action (or team action) within the firm, which in turn leads to organizational action, the associated environmental response, and the resultant organizational learning. Figure 1 illustrates this process.

Figure 1

Individual and Organizational Learning Linkage



Adapted from: Kim, Daniel H. (1993), "The Link Between Individual and Organizational Learning," Sloan Management Review, (Fall), 37-50.

Within this framework, the new product development team member's recommendation of organizational action would likely be based upon that individual's mental model of the new product development process.

Mental Models

Mental models can both facilitate and limit manager's attention to salient information about environmental change. This may cause managers to overlook important environmental factors which in turn can lead to inappropriate strategic decisions. Organizational learning theory has made important contributions towards an understanding of how one's personal constructs, or mental models, can influence an organization's actions. This is followed by the organization learning from its strategic choices (Kim 1993). Organizational renewal requires that managers change their mental models. Failure to reorganize an individual's mental model in the face of environmental change can lead to organizational decline (Barr, Stimpert, and Huff 1992). In order to facilitate this renewal, decision makers must first understand their currently held mental models. A better understanding of the causal direction of mental models could provide insight to the influencing interactions between marketing and

R&D departments involved in the new product development process (Ruekert and Walker 1987a). In addition, an understanding of an individual's mental model used in a new product development decision is necessary for devising training programs (Rouse and Morris 1986).

Team Interaction

In order to reach the idealized dual approach (incorporating a customer focus and technological orientation) proposed by scholars, the differing mental model beliefs must be understood. By giving team members an understanding of, not only their initial orientations, but other team member's beliefs and expectations as well, chances for meaningful communication can be enhanced within new product development teams (Gupta and Rogers 1991).

Without this understanding, new product development teams may be susceptible to the problems of group dynamics such as political behavior, argumentation, and personal power (Schwenk 1988). Understanding partisan interplay is critical to understanding the role that marketing performs in negotiating strategy between constituency cores (Frankwick et al. 1994). Day and Nedungadi (1994) state that what matters are the mental models that managers use to develop strategies. The mental models allow managers to make sense of a more and more complex world. If group dynamics overtakes a clear vision of what occurs in the world, a lack of strategy-environment fit could occur. While a study of group dynamics and power relationships is beyond the scope of this study, this study investigates the underpinning of core

constituency beliefs which can lead to an understanding of perceptual differences (Schwenk 1988).

Mental models act as cognitive short-cuts. The mental model an individual holds provides a framework which can make it unnecessary for the decision-maker to expend mental effort to diagnose completely each element of a new strategic problem. In addition, an individual's advocacy and the use of that mental model tends to increase the individual's belief in that schema structure. Groups can have the same informational biases as individuals (Rouse 1992; Schwenk 1988; Walsh, Henderson, and Deighton 1988). When this moves into the political process, a group's advocacy of their position can again increase the commitment to that group's shared mental model. This lack of willingness to change can lead to strategic momentum as cited by Miller and Friesen (1982).

Antecedents to Mental Models

An individual's background knowledge constrains his or her ability to interpret and understand the environment. Limited knowledge can lead to a "bounded rationality" problem (Schwenk 1988; Simon 1991) where the individual decision maker utilizes selective perception and selective interpretation of complex events. These decisional biases may affect strategic decision making (Schwenk 1988). Japanese firms have attempted to overcome this problem by utilizing cross functional teams, and cross functional training (Moenaert and Sounder 1990; Song and Perry 1992). For example, Japanese firms rotate personnel among positions which facilitates understanding of differing viewpoints within the firm (Gold 1987) which can result in Japanese decision

makers in companies employing highly flexible role schemes (Moenaert, Sounder, De Meyer, and Deschoolmeester 1994). This allows for the marketing and R&D engineers within the Japanese firm to develop constructs from more than just within their own constituency area.

American firms have begun using cross functional teams, but do not have the level of cross training of Japanese firms (Moenaert, Sounder, De Meyer, and Deschoolmeester 1994; Song and Perry 1992). Re-education and re-training can give team members an understanding of their own and other's mental models. If team members understand the antecedent factors which lead to these mental models, they will have an expanded educational and training perspective which could lead to less narrowly constrained mental model perceptions and improved communication.

While it is beyond the scope of this study to investigate all of the antecedent factors such as personality or the individual's information processing system (which can not be managerially retrained), the user's education, technical background, and previous experience has been shown to lead to the development of mental models (Miller and Wager 1971; Norman 1983).

Organizational Learning

Organizational learning has been a focus of interest in the fields of organizational theory, industrial economics, economic history, management, and innovation (Dodgson 1993). It has just recently been a focus of study in marketing (Sinkula 1994). McKee (1992) believes that organizational learning is a key strategic variable and can be an underlying variable explaining performance and strategic action.

An organizational learning perspective uses individual learning theories as a model for how an organization learns. Organizations are believed to learn through the accumulation of knowledge held by individuals as well as in the culture and records of the firm (Dodgson 1993; Kim 1993). The organization can be seen as a system which learns from its environment. Individuals in the firm can respond to the environment through an operant conditioning learning process (by responding to rewards and punishments), or they can act proactively by anticipating the environment. A number of studies have noted that a firm's strategic orientations can change over time from more innovative to more customer driven as the firm gains experience with its customer base (Gold 1987; Roberts 1990).

Mental Model - Organizational Learning Linkage. Individual mental models set the frame of reference for how the organization learns from its environment, and how the organization decides to operate within that environment. This is consistent with Anderson's (1982) constituency bargaining framework (Frankwick et al. 1994). Without an understanding of individual mental models, little organizational learning will take place (McKenna 1992).

This study attempts to meet Dodgson's (1993) call for research on understanding the way in which learning results in organizational change by building on Kim's (1993) organizational learning theory through outlining how an individual's mental models, or views of the world, are brought into the firm to add to the organization's knowledge and memory.

While the behavior in complex organizations is characterized by a number of learning processes, each individual and each core group within the firm has their own

knowledge base and their own learning capabilities. The structure of the organization helps to define the way in which these processes interact (Chandler 1962) and gives rise to the organizational learning process resulting from these interactions (Dodgson 1993). A challenge for researchers is to make mental models explicit – this requires developing a tool to capture and communicate them. Making mental models explicit should accelerate individual learning because individuals can gain shared meaning and the organization's capacity for effective coordinated activities increases (Kim 1993).

Strategic Choice

By gaining a better understanding of the firm's marketing and technical core's personal constructs, or mental models, as related to the new product development process, a richer understanding of the marketing/R&D interface can be gained. Within this framework, scholars have called for research on how individuals use and evaluate information in the new product development process (Aaby and Discenza 1993; Gupta and Rogers 1991; Kim 1993; McKee 1992; Meyers and Wilemon 1989; Sinkula 1994).

Meyers and Wilemon (1989) have called for specific research in the new product development area:

Given the advancement of general concepts about organizational learning, it is time to launch more specific empirical research to discover more precisely the factors which influence specific types of organizational learning. The ultimate goal here is to improve and accelerate the rate of successful outcomes of distinct managerial endeavors such as new product development (pg. 81).

New product development teams meet Meyers and Wilemon's requirements of a "high learning" environment that have identifiable and trackable units involved in rapid change.

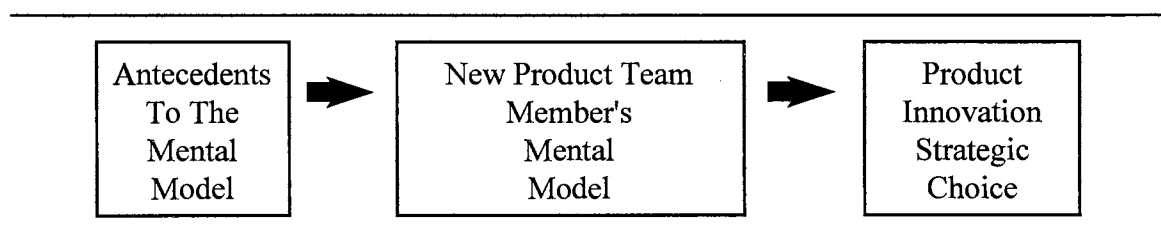
Research Is Needed

Previous research has investigated some of the proposed relationships. Of the antecedents to the mental models, personality differences have been investigated (Lucas and Bush 1988; McDonough and Barczak 1992) as well as training, education, and experience (Aaby and Discenza 1993; Pavia 1991; Norman 1983). Over time, team members can adapt themselves to the new product development process which can enhance efficiency and effectiveness (Anderson 1982; Day and Wensley 1983; Gupta and Rogers 1991).

Little empirical work has been undertaken to operationalize the mental models related to new product development. While considerable research has been undertaken to identify the nature of the relationships between marketing and R&D constituencies within the firm, little research has been undertaken to identify how these two constituencies differ in their approach to evaluating product innovations, or to the antecedents which can lead to the development of those mental models. Figure 2 illustrates the general outline of the present study.

Figure 2

General Outline of Present Study



Research on the specific mental models that individuals hold in the new product development process can lead to the identification of the mental constructs which could be related to the type of product innovation chosen. In addition, the relationship between antecedent factors and the resultant mental model constructs can lead to an understanding of the development of mental models and lead to strategies for reforming education and training of new product development team members. Within this domain, additional research must be undertaken. A review of the literature reveals that research is limited in:

1. Differing orientations to new product development have been posited to exist within the firm. These extremes can be conceptualized as being anchored by a technological orientation (Aaby and Discenza 1993; Crawford 1991b; Lucas and Bush 1988; Nyström 1985) and at the other extreme, a more market driven orientation (Nyström 1985; Shanklin and Ryans 1987; Urban and Hauser 1993). Given this, little empirical work has been undertaken to identify the beliefs or operationalize the mental models that represent these extremes which new product development team members can hold.
2. While speculation exists that these orientations can influence the choice of product innovations (Bennett and Cooper 1979; Lawton and Parasuraman 1980; Tauber 1974), no research has been undertaken to identify the specific mental model constructs which would be related to the choice of product innovations.
3. While there is wide consensus that a number of antecedents influence mental models (Miller and Wager 1971; Norman 1983; Schwenk 1988), no research has been undertaken to identify which of the antecedent factors influence the new product evaluation mental models. An identification of those antecedent factors

can lead to educational and training regiments which could improve new product development team interactions.

Thus, important objectives for future research would be to integrate and extend research on these existing concepts by developing measures of an individual's mental models related to the new product development process, identifying the antecedent factors, and determining how those mental model beliefs could be related to product innovation choice.

Purpose of Present Study

The present study seeks to make a substantive contribution to research in the marketing - R&D interface in the new product development process by addressing the research needs as noted above. As an exploratory investigation, the primary purpose is to assess the mental model of new product development team members, determine the antecedents to those mental models, and determine which of the mental model constructs affect the choice of product innovations. This study is based upon the premise that individuals within a new product development team can vary continuously in their new product alternative preferences from a market driven approach to a technologically driven approach. The timely questions addressed by the research includes:

1. What are the specific beliefs held in the mental models of new product development team members?
2. Are new product development team member's mental models related to new product development alternatives?
3. What antecedents lead to the development of the new product development team members mental models?

A Substantive Contribution

This study makes a substantive contribution to the field of marketing, specifically to the marketing - R&D interface literature. Existing research is extended, constructs are defined and conceptual relationships are empirically investigated, and new product development team members' personal constructs are identified which are the basis for product innovation choice and the resulting organizational learning.

Mental Model Orientations

This study extends the identification of orientations that individuals within the firm may hold by identifying the personal constructs, or mental models which are related to those orientations. A direct result of this study will be the identification of the components of an individual's mental model which are related to that individual's product innovation choice. As yet no empirical work has been undertaken toward identifying mental models held by new product development team members.

Organizational Learning

This study borrows from organizational learning theory and links it to the marketing -R&D interface in the new product development process. By exploring the individual's mental models, areas in which individuals may differ in the new product development process can be identified. These are the basis for how the organization learns and, in turn, reacts to the environment. This has strong managerial relevance in

identifying the areas of contention which can arise between marketing and technology team members in the new product development process.

Relationships Between Antecedents and Mental Models

To be competitive, firms must not only produce new products, they must get them to market quickly. By investigating the antecedents to the mental models, it is hoped to identify the components which lead to differences in perceptions, and therefore to possible contention in the new product development process.

In summary, this study develops and tests theory relating mental models in the marketing - R&D interface. This theory suggests that differences in individual antecedents influence the development of mental models which impacts the interface and the resulting product innovation choice.

CHAPTER II

LITERATURE REVIEW

Given the timeliness and importance of new product development in marketing, this section organizes and reviews key research domains relevant to the present study. Principle areas to be explored include the new product development process, alternative approaches to new product development, the marketing - research and development interface (hereafter referred to as the technical core to represent those firms without a formalized research and development department, but with engineering or technical constituencies), mental models as related to strategic choice, and antecedents to the development of constituency new product development mental models.

Consolidating this literature will establish and validate a model to understand how new product development team members' mental models influence new product alternative choice. A variety of domains are examined for their contribution to understanding the new product development team interactions. While this research is grounded in the new product development process (Calatone and Benedetto 1988; Cooper and Kleinschmidt 1986; Crawford 1991a; Feldman and Page 1984; Mahajan and Wind 1992; Moore 1987; Urban and Hauser 1993), research has pointed out that in the marketing-technical core interface (cited in the literature as the Marketing/R&D interface: Gupta, Raj, and Wilemon 1985, 1986; Gupta and Wilemon 1988, 1990,

1991; Hise et al. 1990; Thamhain 1990) new product development teams play an important role in achieving new product success (Cooper 1984; Crawford 1991a; Hise, O'Neal, Parasuraman, and McNeal 1990). It is believed that through the team's sharing of their individual skills, perspectives, and alternate approaches to new product development, competitive advantages can be reached (Cooper 1984; Crawford 1991; Gupta and Rogers 1991; Hise, O'Neal, Parasuraman, and McNeal 1990). Yet the literature has shown that this interface is anything but harmonious (Gupta, Raj, and Wilemon 1985; Gupta and Rogers 1991; Gupta and Wilemon 1988; 1990; 1991; Moenaert and Souder 1990; Vesey 1991).

By linking theory from mental models and organizational learning (Gupta and Rogers 1991; Kelly 1955; Kim 1993; and Rogers and Rogers 1976) this study adds to the fundamental understanding of the marketing-technical core interface in the new product development process.

Figure 2 outlined the relationship between constructs for this study. The first area which will be explored is the strategic alternative new product choices that individuals prefer. This will be followed by an analysis of the mental model constructs which represent the mental models of new product development team members. Finally, the antecedents to the mental model development will be discussed.

Alternative New Product Strategic Choice

A number of researchers have determined that there is no single NPD process accepted by all companies across all industries (Calatone and Benedetto 1988; Cooper and Kleinschmidt 1986; Crawford 1991a; Feldman and Page 1984; Mahajan and Wind

1992; Moore 1987). The steps which are often eliminated or shortened are those the marketing core may consider to be the most important. A study by Cooper and Kleinschmidt (1986) indicated that of the thirteen steps in their "skeleton" of the NPD process, two marketing steps are least often used: test marketing or trial sales (used in only 22.5% of the cases studied) and a detailed market study or marketing research (undertaken in only 25.4% of the projects).

While individual firms adjust their new product development process based upon their needs for efficiency (Feldman and Page 1984), generalized paradigms for the new product development process have been proposed across the literature. Appendix A outlines two of these frameworks. Kotler's (1991) framework is a normative demand based model. This framework focuses on marketing's concerns over meeting the needs of the customer. Ideas are developed based upon customer needs, tested against the target audience for acceptance, and are then commercialized. This process reduces risk by focusing on the customer's expressed needs.

The marketing - technical core interface framework outlined by Urban and Hauser (1993) and Crawford (1991a) is more proactive in that all ideas do not need to spring from the expressed needs of the customer. By looking for future opportunities the firm can act proactively (as recommended by Wind and Robertson (1983)). This leads to designing products through a marketing - technical core interface in order to meet customers needs, even if these ideas are not well articulated by the market.

These alternative new product development paradigms can be related to Dickson and Giglierano's (1986) "missing the boat" and "sinking the boat" risk orientation tradeoff. In this conceptualization a firm can sink the boat by missing the targeted

market's needs. Yet, at the same time, a focus which is too strongly oriented to the expressed needs of the markets can miss the boat, or new market opportunities.

While the individual stages and approaches within these stages can vary across literatures, Urban and Hauser's (1993) framework (opportunity identification, design, testing, introduction, and life-cycle management) can be generalized across most new product development processes.

The Opportunity Identification Stage

The first stage in the new product development process is the opportunity identification stage. This stage can be considered to be the most important in that it is the initial filter through which new product development alternatives must pass before they move through the following stages. Up-front investments in this area can lead to lower risk and improve chances of new product success (Urban and Hauser 1993). Hise et al. (1989) found that the more up-front activities a firm undertakes (opportunity identification and design), the higher the chances of new product success.

At the opportunity identification stage, the new product alternative is considered for further analysis. Cooper and Kleinschmidt (1986) found the initial screening process to be the weakest activity and needing the most improvement in the new product development process. While Cooper and Kleinschmidt's study of 252 new products found that most often go/no-go decisions were made by groups (59.5%) followed by single individuals (23.7%), these decisions were done informally with no checklist for formalized evaluative criteria. In addition, Hauser and Clausing (1988) proposed that by encouraging communication among functional groups at the early

stages of the design process, design time could be reduced by 40% and design costs by 60% while maintaining or enhancing design quality.

This view that organizations need more work on understanding the idea generation stage is backed by Conway and McGuinness (1986) who state that not much is known about the way that organizations search for new product ideas. Conway and McGuinness found that firms adopt a variety of search methods to identify market opportunities. When core constituencies bring their mental models, or views of what type of ideas are acceptable to the new product development team, differences are likely to result in contention between team members. The harmony/disharmony in the team can have a direct result on new product development success. Souder (1988) found that the disharmony between marketing and R&D was directly related to chances of new product success. For projects with severe disharmony, 68% failed while the failure rate for mild disharmony was 23% and for harmonious relationships only 13%.

The question this study proposes is related to the nature of the core constituency's mental models. The identification of core constituency mental models can result in an understanding of the other constituency's concerns as well as one's own biases (Kelly 1955; Rouse 1992; Schwenk 1988). In addition, by identifying the antecedents to the mental models, training can be developed for the firm as well as for educational systems.

This study will now turn to the alternative new product development strategies cited in the literature. This literature review gives insights into alternatives which can represent the mental constructs held by differing constituencies involved in the new product development process.

Product Development Strategies

Alternative new product development strategies can exist on a continuum from simple product variations to totally discontinuous innovations. It has been speculated that the extremes of this continuum are anchored by isolated marketing and technical approaches respectively. A dual approach to new product development (Aaby and Discenza 1993; Crawford 1991b; Lucas and Bush 1988; Nyström 1985) implies a melding of both technologically-driven approaches and market-driven approaches. These are, in fact, strategic alternatives utilized by the firm. A new product development team dominated by a firm's culture which is overly market-driven can kill innovation, while an organization which is too innovative will yield products with no market need. Aaby and Discenza (1993) have noted that for firms to be competitive, technically oriented firms must incorporate increased customer orientations, and marketing oriented organizations must innovate and incorporate new technology. Both approaches may exist in the same firm at the same time, yet work on parallel tracks. Regardless of which core has the power dynamics within the firm, when the two constituencies interact, communication strains and product development delays can develop.

In addition to the choice of new product alternatives, when a firm's dominant culture is too biased towards a particular mental model perspective, a number of other implications arise such as the fit between the strategy and the environment (Miller 1992; Miller and Friesen 1982), the ability of the organization's culture to work with alternate strategies (Frankwick et al. 1994; Miles and Snow 1978; Workman 1993),

and the influence that the organization's culture can have on the team dynamics (Workman 1993). For example, Workman (1993) found that a firm's engineering-driven culture justified not listening to the marketing core's input into the new product development process.

Dual Approach

A dual approach requires that new product development team members must understand their own, as well as their team members' mental models, or views of how to best approach a new product development alternative. As this study attempts to tap into the mental models of individuals within the firm, the following literature review is related to the extremes in beliefs which these individuals can hold. No doubt, team members can exist along a continuum between these extreme orientations. Identification of these initial orientations can set the extremes used by new product development team members to identify the approaches brought into the new product development process. These approaches will directly impact the nature of the opportunity evaluation stage of the new product development process.

In addition to Crawford's (1991b) view that both market and technology-driven strategies exist (which should be combined into a dual strategy), many other researchers have outlined the extremes of a number of orientations to new product development.

Urban and Hauser (1993, pgs. 19 - 23) outline two alternative product development strategies: reactive and proactive. These broad approaches to new product development can act as the basis for identifying alternative firm orientations.

REACTIVE

"A reactive product strategy is based upon dealing with the initiating pressures as they occur." (pg. 19)

Reactive Strategies

Environmental Scanning oriented.

Defensive protects the profitability of existing products by countering competitive new products.

Imitative quickly copies a new product before it becomes successful.

Second-but-better copies and improves the competitive new product.

Responsive purposively reacting to customer's requests.

PROACTIVE

"A proactive strategy would explicitly allocate resources to preempt undesirable future events and achieve goals." (pg. 19)

Proactive Strategies

A proactive company does preemptive R&D and product development.

R&D Effort to build technologically superior products.

Marketing can identify customer's needs and develop products which satisfy those needs.

Entrepreneurial a special person has an idea and makes it happen (or product champion).

Urban and Hauser also point out that production and finance play a role in the new product development process. But at the initial phases, it is marketing which has the role of representing the customer in the design process. R&D has an important role at the beginning of the process, but diminishes as the process continues.

Shanklin and Ryans (1987) indicate that two approaches exist: a demand-side and supply-side approach. Note that this is related to high technology products.

DEMAND-SIDED

Individuals educated under a demand-sided approach (as most marketing texts have been focused) believe that market demand should precede and trigger product development and be the formulation and funding of marketing strategies.

SUPPLY-SIDED

Supply-sided marketing refers to any instance where a product can create a market - or the product itself is responsible for the demand.

Shanklin and Ryan note that in successful high-tech companies, the technical core is not allowed to simply develop products independent of market considerations. Instead, product innovation ideas are based upon market opportunities. This parallels Urban and Hauser's view of proactive marketing. Lucas and Bush (1988) use this same typology to investigate individual personality factors for the technical core and marketing managers.

Nyström (1985) notes that a technological orientation has been receiving wider attention in the literature. Firms were moving from a reliance on marketing for product development and were moving towards a technical orientation:

MARKETING STRATEGY

The product focus of a marketing strategy is related to the company's concentration on developing product variations versus product diversification.

Competitive Outcome: The measure of market outcome was the uniqueness or the interchangeability of the product from the buyer's point of view. The more unique, the greater the market potential.

Financial Outcome: What was the profitability of the product over its life cycle.

Closed Strategy

Isolated technology orientation, product modification, and an emphasis on existing customers are elements of a closed strategy.

TECHNOLOGY STRATEGY

A technology orientation refers to the extent to which a company relies on its own internal technical competence or depends on outside sources.

Technological Outcome: The main measure of a technological orientation is technological innovation. The goal is to develop a novel or unique technological solution to the problem. This can lead to patent protection but at the same time requires a longer development time.

Open Strategy

Synergistic technology use and external technology orientations contribute to an open strategy.

Bruce and Rodgus' (1991) analysis of innovative companies in the enzyme industry found that two main strategies were used for innovating.

GROUP ONE

Great effort is put into product marketing, maintaining links with customers and establishing links to leading edge customers (Von Hippel's (1986) lead users). The technical core's efforts were directed toward solving consumer problems.

GROUP TWO

Great effort is put into the technical core and design. Effective marketing (product push) should give them a competitive advantage.

Conway and McGuinness (1986) identify six alternative orientations utilized by nine technology based firms. Of these six, two entailed diversification into new markets and will not be summarized below.

CUSTOMER-DRIVEN

The problem or opportunity identification arose from a specific customer's needs.

CLOSE-FOLLOWER

The problem or opportunity identification arose from the company's matching a new product developed by a direct competitor.

MARKET-DRIVEN

The problem or opportunity identification arose from the company's specific strategy of serving a defined market and through the subsequent interaction with the needs of that market.

TECHNOLOGY-DRIVEN

The new product concept arose directly from a technological discovery or from the availability of a new technology.

Ruekert and Walker (1987a) have found that the main contentions between the marketing core and the technical core tend to be a perceived lack of customer orientation or knowledge among technical core personnel. For the technical core the main contention was found to be marketing personnel reacting too quickly in response to the market-place.

While team members are likely to hold beliefs along a continuum, the information above indicates that this continuum can be anchored by two basic orientations. a technically driven orientation and a market driven orientation. Both

orientations share a focus on customer needs, yet differ on how those needs are assessed, how products are developed to meet those needs, and the expected outcomes.

In summary a technically driven orientation seems to develop new products by focusing on ideas based upon market opportunities and uses the technical core's efforts to build technologically superior products. The technical superiority of the product should give the firm a competitive advantage by shifting market demand to the product produced. These products may be more discontinuous innovations in nature due to the more internal development of the product idea.

A market driven orientation seems to develop new products by responding purposively to customer's expressed needs. These firms believe that market demand should precede and trigger product development and be the foundation of marketing strategies. The products are likely to be continuous innovations in nature due to the idea for the product being derived from the customer's experience with past products.

Linking Theory - Mental Models

While studies of organizational learning encompass a wide range of theories and applications, this paper follows Kim (1993) in viewing individual mental models as the first stage in organizational learning theory by identifying mental models and their impact on strategic choice. Kim (1993) proposes that individuals' mental models, which can be compared to Kelly's (1955) personal construct theory, help individuals make sense of the world they see, but at the same time can restrict individuals' understanding to that which makes sense within their own mental models. Mental models are related to the process of selective perception and interpretation, and in

addition, can direct strategic action (Barr, Stimpert, and Huff 1992). Mental models are not the same as a memory schema, or a mental map. Mental models play an active role in what an individual sees and does and represent a person's view of the world including explicit and implicate understandings.

Mental models are conceptual models used by individuals to understand physical systems. Mental models exist in the individual's mind and guide that individual's ability to make predictions of future events. Mental models are, by their nature, incomplete, unstable and do not have firm boundaries. Yet they control and constrain behavior. In addition, an individual's ability to utilize the model is limited. A mental model provides a framework which makes it unnecessary for decision-makers to expend mental effort to diagnose completely each element of a new strategic problem (Schwenk 1989). While engaged in a physical task, individuals may prefer extra physical activity over changing their mental model of how to perform that task (Norman 1983).

Individual's are constrained in their ability to interpret and understand their environment. This can lead to an individual's "bounded rationality" (Schwenk 1989) in making decision and to the individual's selective perception and interpretation processing. Theorists have considered it vital that the individual in the firm be able to unlearn as well as learn. It is the process of unlearning, as much as learning new information, which allows new knowledge to be developed (Dodgson 1993).

As has been stated above, both the marketing core and the technical core begin their constituency negotiation with their own mental models or mental constructs. Kim (1993) has noted that technically focused companies may be inwardly directed while

marketing focused firms may be outwardly focused. These two axis may represent differing *weltanschauung*, or views of the world. These mental models or beliefs lead to individual action within the firm, which in turn leads to organizational action and an associated organizational response.

The sections above have outlined how the marketing and technical core's mental models interact in their interpretation of the environment which in turn leads to organizational action and environmental response. As yet little work has been done to operationalize and test each core's mental model as it relates to interfacing with the other core. Without this understanding, little progress can be made in determining how these two constituencies interact in the new product development process leading to new product development speed and new product development success.

Marketing/Tech Core Interface

Gupta, Raj, and Wilemon's (1986) model on the technical core - marketing interface centers on the sociocultural differences between these two cores in the firm. These differences are seen as the result of education and socialization. Personal construct theory (Kelly 1955) posits that individuals develop differing schemes of the world, through education and socialization, which influence the way in which that individual anticipates and perceives events. When two individuals share constructs, they can communicate more effectively. This is further developed by Rogers (Gupta and Rogers 1991; Rogers 1983; Rogers and Rogers 1976) who indicates that between source and receivers, where there is homophily (individuals share attributes of beliefs, education, or social status) communication will be facilitated. Under conditions of

heterophily (individuals do not share attributes of beliefs, education, or social status) communication will not be facilitated.

Communication barriers have been found to be the single most important barrier to the marketing and technical core interface in the firm (Bruce and Rodgers 1991; Gupta Raj, and Wilemon 1985; Moenaert and Souder 1990; Vesey 1991). Gupta and Rogers' (1991) theoretical framework for integrating the marketing and technical cores within the firm is based upon a communication model, the diffusion of innovations. As with most new ideas, resistance is the norm rather than the exception. For new product ideas to be acceptable to all constituencies, the diffusion of innovations literature indicates that the idea must have a relative advantage over older ideas, have compatibility with existing values, and be related to past experience. In addition they must meet the needs of potential adopters, have low perceived complexity, have trialability, and have observability (Rogers 1983; Rogers and Rogers 1976).

Moenaert, Deschoolmeester, De Meyer, and Souder (1992) recognized that relatively little research has been undertaken to investigate the marketing/technical core interface at the individual level where communication occurs. Their study investigated the communication styles of marketing and technical cores representatives within the firm. They called for further research into models investigating communication-based interactions between marketing and technical core individuals. McKee (1992) believes that communication barriers between functional areas (marketing and the technical core) are due to differences in functional perspectives (mental models) and can inhibit innovation.

Researchers have investigated the problems inherent in the marketing - technology core interface. The major barrier to integration has been found to be the lack of communication. The second most important barrier is insensitivity to other's points of view. Specifically the marketing core has been found to be dissatisfied with their lack of involvement in setting product design to meet customer's needs. The technology core was dissatisfied with marketing's ability to find commercial applications for product ideas and technology, marketing's lack of sharing of information, and marketing's inability to understand the technology (Gupta, Raj, and Wilemon 1985).

Construct Components

This paper will now move toward identifying the marketing core's and the technical core's mental models. Differences, or degrees of variance (Latta and Swigger 1992), are known to exist between individual beliefs. These differences, which are developed from contrasting experiences, learning styles, and educational experience, can lead to professionals taking extreme positions toward each other's opinions (Weinrauch and Anderson 1982). Urban and Hauser (1993) have noted that marketing managers are not trained technically, tend to have short-run perspectives, prefer structured tasks, and are often outgoing. Engineers and scientists often lack training in marketing and management, tend to focus on long-term results, are comfortable working in unstructured tasks, and are frequently reserved.

Given that the marketing and technical cores have different thought worlds (Frankwick et al. 1994; Ruckert and Walker 1987b), or mental models, an

understanding of the partisan interplay between cores is critical to understanding the role that marketing performs in negotiating strategy. By identifying the cognitive maps of new product development team members, the process through which the beliefs of actors (constituency members) are melded into decisions can be understood (Frankwick et al. 1994).

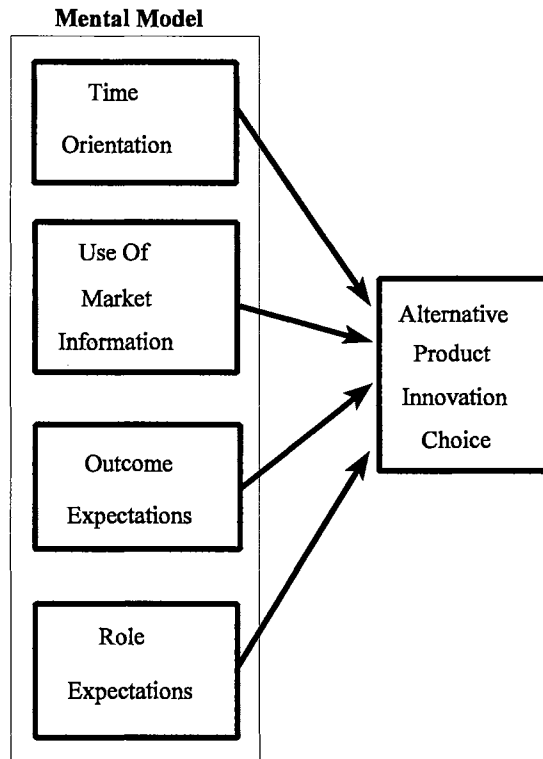
Differences in mental models don't necessarily imply that the marketing core and the technical core have differing goals in terms of new product success or long term firm success. Rather, given the differing mental models, the strategy which the firm should undertake to reach successful outcomes may differ. It is in the process of negotiating these strategic alternatives that the differing mental models inhibits communication.

The most important areas where negotiation is needed (as cited by Urban and Hauser 1993) are in customer requirements, feedback on product performance, information on competitors, product development according to market needs, and setting of new-product goals and priorities.

Figure 3 outlines the proposed mental model variables which have been theoretically linked to differences between the marketing and technical core within the new product development process. The mental model constructs to be examined include: time orientation, market information, outcome expectation, and role expectations.

Figure 3

Mental Model Components



Time Orientation

Lawrence and Lorsch (1967; 1969) found in their research that individuals involved in marketing (sales) had shorter time orientations than those involved in the technical (R&D) side of the firm. Lawrence and Lorsch's research attributed this difference in time orientation to the length of time that each core needs to receive feedback from the environment. The marketing core was engaged in activities which enabled them to receive feedback at a much shorter time rate than those in the technical

core who would have to wait for feedback from technical undertakings. This time orientation has been noted by a number of other scholars and researchers (Gupta, Raj, and Wilemon 1985a, 1986; Kamath, Mansour-Cole, and Apana 1993; Urban and Hauser 1993). The general agreement is that marketing managers tend to have short-run perspectives while engineers and scientists tend to focus on long-term results. Pavia's (1991) research findings led her to believe that business training may lead to more short-term time horizons where decision makers may rely on short term measures. Technologists have received training in a hard science, and perceive their work as the production of technology (McNulty and Whittington 1992). The production of technology can lead to patent protection, but this requires long-term development (Nyström 1985). Following customer demand, on the other hand, may lead to short term innovation (McNulty and Whittington 1992).

These differences in perspective can lead to conflicts when the cores are engaged in joint projects. Reukert and Walker (1987a) found that marketers complained that the technical core was not able to respond quickly enough to changes in the marketplace due to slow response times and the technical core lacked an understanding of the response time necessary to be competitive. The technical core, on the other hand, saw marketers as too quick to respond to the market. Marketers are seen as rushing new products to the market before they can be technically refined.

Formalized Marketing Information

As noted, a study by Cooper and Kleinschmidt (1986) indicated that in the new product development process, two formalized marketing research steps are least often

undertaken: test marketing or trial sales (used in only 22.5% of the cases studied) and a detailed market study or marketing research (undertaken in only 25.4% of the projects). The utilization of marketing information is an attempt by the firm to meet the needs of the market. Unfortunately this process may be perceived differently by the differing cores within the firm. Frankwick et al. (1994) noted that both the marketing core and the technical core believed that they understood the needs of the customer. This difference in view can be related to the nature of each core's understanding of the market.

For market driven firms, formalized marketing research (concept testing, product prototypes, and market tests) can provide the feedback necessary to assess the market's response. For more innovative or technically driven firms, little stock may be placed in mathematically-based marketing research. Rather, there may be a reliance on qualitative marketing research (focus groups) due to the small amount of historical data (new technology doesn't fit with customer's experience) (Shanklin and Ryans 1987). This perspective fits within Von Hippel's (1986) view of using "lead-users" who are more product class experienced than the general customer.

Researchers have noted that the utilization of formalized marketing research has been a point of contention between the marketing and technical core within the firm. Reukert and Walker (1987) found that the technical core believed that marketers were not able to supply information on customer needs which are not met by current products.

Gupta and Wilemon (1991) found that the reason the technical core would not accept marketing's information was due to the perception that the information did not

focus on customer's real needs, marketers were not technically sophisticated, the information was biased to marketing's short term interests, and the focus was reactive rather than foreseeing real customer needs or competitive threats.

The type of information upon which the firm relies may change as the firm evolves. Roberts (1990) found that entrepreneurial firms initially rely upon the founder's feel for the market's needs rather than research. The use of formalized information is expected to increase as the organization ages.

Outcome Expectations

Lawrence and Lorsch's (1967; 1969) early work found that the marketing core was more focused on the market environment while the technical core was focused on the technical environment. Both of these cores would be concerned with the long term health of the firm, but the perceived method of reaching that goal may differ. Reukert and Walker (1987) found that major points of contention between marketing and technical cores existed in a lack of clearly defined goals and conflicting goals between constituencies.

The marketing core's business training may lead them to look at the health of the firm deriving from immediate sales and profits. The marketing core may be interested in projects which lead to "market" successes (even with marginal financial returns) (Gupta, Raj, Wilemon 1986; Maidique 1984). This may protect the profitability of existing products by countering competitive new products (Urban and Hauser 1993) and result in maximizing sales or market share (Ruekert and Walker 1987). This results now, ROI orientation (Hayes and Abernathy 1980) could be used

by the marketer to differentiate between a go and no-go for a new product alternative (Pavia 1991).

The technical core, on the other hand, may see the long term health of the firm as being derived from new technology and innovation. Technology can lead to new strategies and superior market positions (Frankwick et al. 1994). The technical core may even strive for technical performance for performances sake, even if it does not lead to successful new products (Maidique 1984). While the new technologies may present opportunities to meet customers' needs which were previously latent, this does not imply that ideas are generated in a vacuum – they are often based upon the technologist's view of how to benefit the customer (Urban and Hauser 1993). In addition, the patent protection gained from the production of technology can lead to long term competitive advantages (Nyström 1985).

Role Expectations

Ideally, the role that each core plays in the marketing process will result in a joint effort. Urban and Hauser (1993) state that the marketing core should find customer needs so firms can purposively react to customers' requests. The technical core, on the other hand, should identify customers' needs and help develop products which satisfy those needs. This may seem be a small difference. But when researchers ask the marketing and technical cores to express their opinions of the other core's role, the extreme differences in the mental models are more revealing.

This debate resides within a demand side vs. supply side orientation. The technical core may have a supply side orientation where it is believed that a product

can create a market – or the product itself is responsible for the creation of demand (Shanklin and Ryans 1987). Effective marketing may be perceived as giving the new product a competitive advantage (Bruce and Rodgus 1991).

The technical core may see marketing's role as selling new products due to the technologist's beliefs that technology should drive marketing (McNulty and Whittington 1992). Marketing's role may be perceived as finding applications for technology developments (should create markets). Gupta, Raj, Wilemon (1985) found that one of the major complaints that the technical core had against marketers is that they were dissatisfied with marketing's ability to find commercial applications for the technology.

Antecedents To Mental Models

While there is general agreement that personality, educational training, the user's technical background, and previous experience influence the development of mental models (see Figure 1) (Aaby and Discenza 1993; Lucas and Bush 1988; Norman 1983; Pavia 1991; Schwenk 1988; Weinrauch and Anderson 1982), little research has been undertaken to identify how these antecedents of mental models relate to the process of new product development (Pavia 1991; Schwenk 1988).

By linking the antecedent forces to mental model constructs, it is hoped that a greater understanding will be gained of how mental models are developed. This should facilitate employee development activities and improve the innovation process at the firm level.

Personality: It is beyond the scope of this study to investigate the personality traits which may be construed as antecedents to new product development mental

models. In addition, since personalities are relatively enduring, these can not be changed through training. Future research should be undertaken to gain an understanding of those personality traits which have been found to be linked to the marketing - technical core interface in order to give insight as to how the mental model constructs could be derived (Schwenk 1988). Gupta, Raj, and Wilemon (1986) have stated that if sociocultural differences exist between the technical and marketing core, they would be of significant importance in determining the quality, characteristics, and effectiveness of the interface.

Figure 4 illustrates the relationship between the antecedents and the mental models held by the constituency cores. The antecedents of education, training, and new product development team experience are expected to have a direct impact on the development of mental models.

Educational - Training

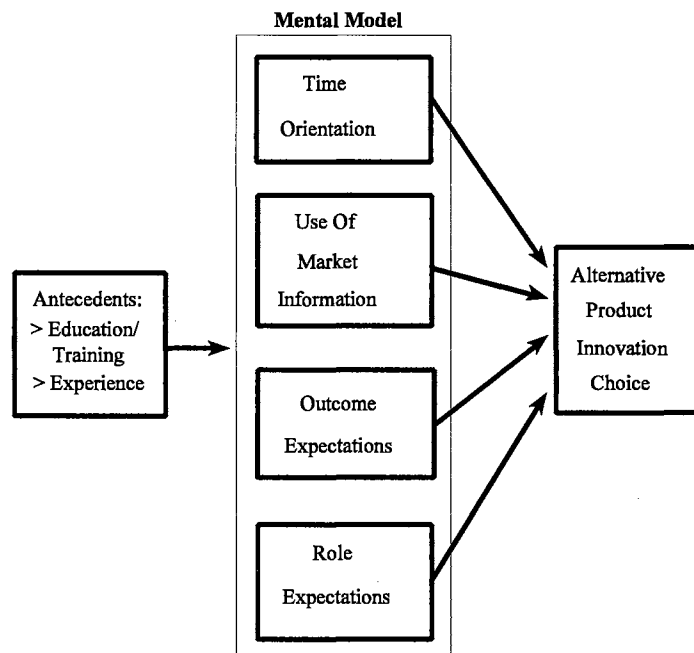
While numerous authors have cited education and training as antecedents to the development of mental models (Gupta, Raj, and Wilemon 1986; Gupta and Rogers 1991; Kelly 1955; Maidique 1984; McNulty and Whittington 1992; Pavia's 1991; Rogers 1983; Rogers and Rogers 1976; Shanklin and Ryans 1987; Urban and Hauser 1993; Weinrauch and Anderson 1982), little if any empirical work has been undertaken to assess the impact of educational training.

Miller and Wager's (1971) early research indicated that the type of individual personality orientation (bureaucratic vs professional) can be related to the type and

length of educational background of an individual. In addition, the educational system and organization itself can tend to reinforce these orientations.

Figure 4

Relationship Between Antecedents, Mental Model, and Strategic Choice



As cited above, the business training of marketers may lead to short-term time horizons (Pavia 1991), a search for projects which lead to market successes (Gupta, Raj, Wilemon 1986; Hayes and Abernathy 1980; Maidique 1984) such as maximized sales or market share (Ruekert and Walker 1987), or a competitive orientation (Urban and Hauser 1993). The technical core has received training in a hard science, and may perceive their work as the production of technology (McNulty and Whittington 1992).

It is possible that the narrower the focus of the training in a particular field, the stronger the mental model of the individual.

Currently the level of education (bachelors, masters, doctoral) and the level of cross training (e.g. engineering undergraduate with masters in business, or post employment training) could be predicted to have an impact on the mental model of the constituency member.

New Product Development Team Experience

It has been noted that experience and learning change the mental model of the individual (Kelly 1955). The nature of the experience that the individual holds could come from like constituencies (e.g. work only with members of the same core on new product development processes) or from differing constituencies (e.g. work with members of other constituency cores on new product development processes).

As internal coalitions interact over time, they can adapt themselves to the new product development process which can enhance efficiency and effectiveness (Anderson 1982; Day and Wensley 1983). For example, closer integration of the technical core with marketing can sensitize technical core personnel to the actual and potential needs of the customers allowing for the meeting of customer needs (Gold 1987). A close linkage between the technical core and the marketing core should lead to the sharing of personal constructs and speed the negotiation process leading to accelerated new product development and to greater chances of new product development success. Frankwick et al. (1994) found that over time, the marketing and technical core within a firm lowered their negative evaluations of a product innovation.

Schoonhoven, Eisenhardt, and Lyman (1990) theorized that the greater experience that the members of an entrepreneurial team have in working together, the greater the trust developed, the more likely they are to have common goals, and the more likely they are to limit conflict and to have common expectations regarding each other's roles in the organization. Communication may also improve. Moenaert and Souder (1990) have proposed that professional and experienced core members would tend to inform the other new product development team core personnel more often than less experienced team members.

CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

The nature of new product choice made by marketers has been a topic of interest in the marketing literature for a considerable time (Bennett and Cooper 1979; Drucker 1954; McGee and Spiro 1988; Morris and Davis 1989; Padmanabhan 1990). This study adds to the empirical support for understanding the linkage between an new product development team member's mental model and his or her new product choice.

In the previous review of the literature, it was indicated that mental models can be predictive of individual choice of new product idea alternatives (Figures 1, 2, 3, and 4) with Figure 4 combining the extant theory and illustrating the model which is the central topic of this study.

Figure 4 indicates that the decision maker's mental model is derived from a number of antecedents. The resultant mental model, in turn, influences the choice of new product idea alternatives. The focus of the present study is on:

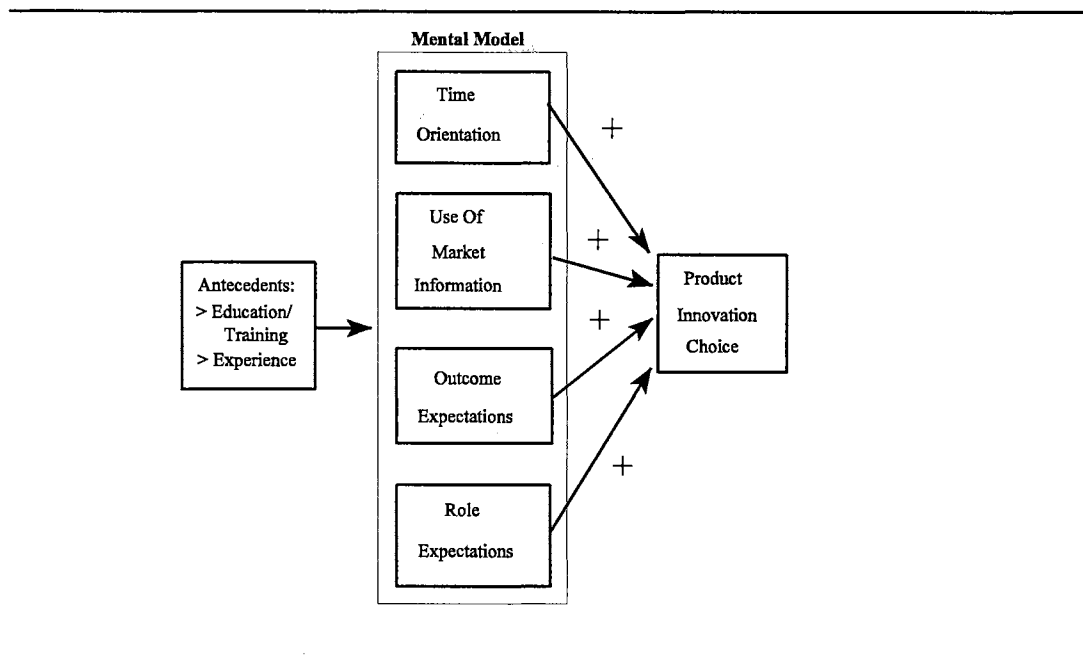
1. the mental model used to make new product development choices.
2. the affect that the antecedents have on the development of those mental models.
3. the resultant new product development alternative choice.

Hypotheses

Investigation of the proposed relationships between the antecedents, mental models, and new product development alternative choice requires that each construct be linearly related in the model. Figure 5 shows the proposed relationships among the constructs for the individuals in the study.

Figure 5

Proposed Relationships Among Key Constructs



This study investigates constructs which are believed to vary between individuals with differing mental models. It is conjectured that the more market driven the individual's mental model, the more likely he or she is to have marketing or business-related antecedents and the more likely they are to choose a market based product variate as a product innovation. Conversely, it is conjectured that the more technically driven the individual's mental model, the more likely he or she is to have technically related

antecedents and to choose a dynamically discontinuous product innovation. For this study, product choice will be defined metrically with a product variation as low and a product breakthrough (discontinuous product) as high. Mental model constructs will be defined metrically with market driven mental models as low and technically driven mental models rated as high.

Based upon the proposed relationships outlined in this study the following hypotheses for the individual can be stated.

H1a: The Time mental model construct will be positively related to the individual's preference for discontinuous innovation.

The time orientation of the individual (the importance of timely response to the environment, with marketers perceived as more short-term oriented) will be related to the type of product innovation chosen. A marketer's proposed short term orientation would be related to product variant choice, where a technically oriented individual's proposed longer term orientation would be related to more discontinuous product choice.

H1b: The Use of market information mental model construct will be positively related to the individual's preference for discontinuous innovation.

The use of market information by the individual (the importance placed on marketing information gathering such as formal marketing research, and/or the type of information provided by the marketing core to the technical core) will be related to the type of product innovation chosen. A marketer's proposed preference for formal marketing research and information gathering would be related to product variant choice, where a technically oriented individual's proposed lack of trust of marketing information would be related to more discontinuous product choice.

H1c: Outcome expectations will be positively related to the individual's preference for discontinuous innovation.

The outcomes that the individual would expect for the firm (the use of criteria such as sales, profits, ROI, market share, and/or technical performance, patents, and new technologies) will be related to the type of product innovation chosen. A marketer's proposed preference for sales, profits, ROI, market share, etc. would be related to a product variant choice, where a technically oriented individual's proposed preference for technical performance, patents, and new technologies would be related to more discontinuous product choice.

H1d: Role expectations will be positively related to the individual's preference for discontinuous innovation.

The role expectations that the individual holds of others in the firm (marketing "should" find customers needs, sell products, find commercial applications, and/or technology "should" develop products, and drive marketing) will be related to the type of product innovation chosen. A marketer's proposed perceptions of his or her role as customer centered and not as pushing products would be related to a product variant choice, where a technically-oriented individual's proposed perceptions of marketers' pushing products would be related to more discontinuous product choice.

Antecedent factors will be considered and will include the individual's educational/training background and the individual's level of new product experience.

H2: There will be significant differences in the relevant mental model measures between individuals with differing educational/training backgrounds.

Given that theory states that one's education and training helps lead to the development of mental models, it follows that the college degree, if any, or any additional on-the-job training could affect the mental model held by that individual.

H3a: The greater the level of new product experience, the weaker the technical orientation of the mental model belief resulting in a negative relationship between the level of new product experience and the mental model construct.

H3b: The greater the level of cross functional experience, the weaker the technical orientation of the mental model belief resulting in a negative relationship between the level of cross functional experience and the mental model construct.

Given that theory states that the greater the amount of cross-functional experience an individual holds the more likely they are to moderate their the mental models, it follows that there will be a significant negative relationship between the individual's mental model and the level of new product development and cross-functional experience.

Research Design

A number of methods have been utilized in the behavioral sciences to attempt to measure mental models. These include protocol analysis, experiments, field observations (Genter and Stevens 1983), information systems analysis (Latta and Swigger 1992), interviews to obtain managers' thoughts (Daugherty 1992), use of semantic networks (Holland and Quinn 1987; Johnson-Laird 1983), interviews used to develop influence diagrams (Bostrom, Fischhoff, and Morgan 1992), sorting methods followed by the use of individual differences multidimensional scaling to elicit individual schema (Walsh, Henderson, and Deighton 1988), and repertory grid techniques (Dunn and Ginsberg 1986; Kelly 1955).

The following material will discuss the research approach used for this study. The first section will explain the field study approach and the choice of the sampling frames. The second section will describe the survey instrument and scales used to measure the mental model, antecedent, and product preference variables. The third section briefly describes the data analysis techniques used in the study.

Field Study

To test the proposed hypotheses, a field survey of practicing marketing core and technical core members was conducted to obtain information on the antecedents, subject mental models, and product innovation preferences. The unit of analysis was the individual.

Survey Approach. Of the methods used to elicit mental models outlined above, Kelly's (1955) use of repertory grid techniques to elicit personal constructs has been widely used by a number of researchers to develop cognitive models. In addition, it has been found that collective frames can be obtained by adding up the individual frames (Dunn and Ginsberg 1986). The development of Kelly's repertory grid parallels the scale development process as practiced in the marketing literature (Churchill 1979). A comparison of Kelly's approach to Churchill's approach indicates the rationale for the methodology used in this study.

	<u>Kelly's (1955) Approach</u>	<u>Churchill's (1979) Approach</u>
1.	Selection of Elements	Specification of Domain and Items
2.	Comparison of Elements to Find Bi-Polar Semantic Differential Items	Scale Development

- | | | |
|----|--------------------|--|
| 3. | Element Evaluation | Relate the Items to the Event, or Relate the Predictor Variables to the Criterion Variable |
| 4. | Grid Analysis | Analysis of Results. |

Unlike Kelly, the present study will employ a survey methodology to assess the relationships between constructs. And unlike Kelly's use of cluster analysis, this study will be based in general linear model procedures. Regression based research has traditionally been used in business literature to assess information across manufacturing and engineering, and general management/marketing and sales groups (Day and Nedungadi 1994; Kamath, Mansour-Cole, and Apana 1993). The use of self reports across businesses has been recommended in the literature because it gave a large and diverse group with common frames of reference (Day and Nedungadi 1994; Moenaert, Deschoolmeester, De Meyer, and Souder 1992).

Sample Selection. To assess the relationships between constructs, a large representative sample of individuals involved in new product development was required. In addition, it is important that individuals with both technical and marketing/business backgrounds be included in the sampling frame. Due to the sample size and the individuals' background requirements, a cross-sectional field study method of data collection was employed. As the sampling frame was at the individual level and not the firm level, questionnaires were sent to individuals. The design of the study elicited individual beliefs and did not require that the subjects be from the same firm, or have worked on the same projects.

In order to obtain individuals with varying backgrounds, three sources were used to obtain subjects. The first source was membership lists from two Society of

Manufacturing Engineers (SME) chapters. This sampling frame included individuals with technical backgrounds and varying levels of new product development experience. The second sampling frame included membership lists from two Product Development and Management Association (PDMA) chapters. This sampling frame included individuals who have a specific interest in new product development and, therefore, had experience with new product development. The third sampling frame came from the Harris Directory database (HARRIS). The list included individuals with marketing/sales positions in manufacturing companies with 100 plus employees in the Central Midwest region.

Data Collection. Data collection was through a two-wave mailing process. The first mailing included a cover letter, questionnaire, and postage-paid return envelope. This was followed two weeks later by a second mailing with a reminder cover letter, another questionnaire, and postage-paid return envelope.

Table 1 outlines the initial number of surveys sent, the number of non-deliverable due to address changes or job shifts. This resulted in a total effective base of 844. Of this number, the first mailing resulted in an overall response rate of 19.2%. The second mailing resulted in an additional 31 surveys bringing the total response rate to 22.9%.

A second mailing was not undertaken for the SME groups. One chapter did not release the name list, but placed the membership labels on postage paid envelopes and then mailed the surveys. The second chapter requested a one-time-only mailing. Due to the high response rate of the total SME group, other chapters were not contacted as a source.

TABLE 1

SUMMARY OF RESPONSE RATE FOR SAMPLING FRAMES

Source		Initial Mailing - Non Deliverable = Total	First Mailing Response (%)	Second Mailing Response (%)	Total Mailing Response (%)
SME	1	159 - 5 = 154	40 (30%)		
	2	220 - 0 = 220	26 (12%)		66 (17.6%)
PDMA	1	130 - 4 = 126	29 (23%)	14 (11%)	
	2	198 - 6 = 192	36 (18.8%)	17 (8.9%)	96 (30.2%)
HARRIS		158 - 6 = 152	31 (20.4%)		31 (20.4%)
TOTAL:		865 - 21 = 844	162 (19.2%)	31 (3.7%)	193 (22.9%)

Many of the mailings to the HARRIS group were sent to the attention of the company presidents. As it is unknown who these surveys were directed to, a second mailing was not undertaken to this group because it would be unknown if they surveys would be forwarded to the same individuals for response.

An analysis was performed to assess nonresponse bias by comparing respondents to non-respondents. Armstrong and Overton (1977) recommend using an extrapolation method by comparing the respondents from later wave mailings to those from earlier mailings. The assumption is that respondents from later mailing will be similar to non-respondents due to the increased stimulus involved in later mailings. The PDMA group was the only group to receive a secondary mailing. As Table 2 indicates, there were no differences found for the hypothesized mental model measures, new product preferences, or experience measures. The extrapolation method suggests that nonresponse bias should not be a major problem in this study. This will be further discussed in the limitation sections of this study.

TABLE 2

COMPARISON OF FIRST MAILING TO SECOND MAILING RESPONDENTS
ESTIMATE OF NONRESPONSE BIAS

Variable	<u>Mean</u>		<i>p</i> - value
	First Mailing	Second Mailing	
New Product Preference	5.117	5.325	.503
Mental Model Measures:			
Time Orientation	4.279	4.428	.298
Marketing Information	4.134	4.036	.583
Outcome Expectations	4.178	4.346	.165
Role Expectations	3.225	3.484	.085
NPD Team Experience	5.688	5.900	.570
Cross-Functional Experience	5.386	5.230	.511

Measurement

To meet the research objectives of this study, antecedent, mental model, and new product preference variables must be identified. The following sections describe how each variable was measured.

New Product Preference. Nyström (1985) has proposed that a focus of a marketing strategy is related to the company's concentration on developing product variations versus product diversification. This is backed by McKee (1992) who looked at continuous versus discontinuous choice in the organizational learning process.

The new product choice that an individual makes will be influenced by a number of factors external to the individual. These could include competitive considerations, firm considerations, and group dynamics. In order to assess the respondents' new product

preference, it was deemed important to minimize the noise created by these factors. To do so required that individuals express their preferences without consideration to their current job or duties.

The new product preference was conceptualized as ranging from preferences for a discontinuously innovative product to a continuous innovation split on the two major criteria used in determining the newness of a product: the amount of technical change involved and the amount of behavioral change expected on the part of the target customer (Gatignon and Robertson 1988).

New product preference was measured on a seven point Likert-type scale with paragraph descriptors. The descriptors range from modest product extensions (continuous innovations) to uniquely new products (discontinuous innovations). This measurement follows Day and Nedungadi (1994) who utilized paragraph descriptors to assess the orientation undertaken by a businesses and Nystrom (1985) who utilized descriptive paragraphs to assess strategic intent. The two items with the associated instructions are shown in Table 3.

A simple correlation was run on the two items. A high significant correlation indicated that these two items measured one domain, that of the individual's new product preference.

TABLE 3

NEW PRODUCT PREFERENCE QUESTIONS

Instructions: An organization can be involved with a variety of new product projects over time. For the next two questions, please indicate the new product project on which you would personally prefer to participate if you were given a choice. *This preference should be regardless of your current business responsibilities.* Choose anywhere along the scale from 1-7.

1. Technical Change:

A product which has small changes or is a minor <u>variation of a current product.</u>	A major enhancement to a product, based on the use of <u>conventional technology.</u>	A major enhancement to a product, based on the use of <u>new technology.</u>	A new <u>breakthrough</u> product with <u>no link</u> to existing technology - or could be a new unique use of technology.
Please Circle:			
1	2	3	4
			5
			6
			7

2. Behavioral Change:

A minor product improvement which <u>customers would perceive</u> as similar to current products.	A major product enhancement where <u>customers must make modest changes in current skills</u> to use the new product.	A major product enhancement where the <u>customer will have to learn new skills</u> to use the product.	A breakthrough product where the <u>customer needs to learn new behavior patterns</u> as well as new skills to use the product.
Please Circle:			
1	2	3	4
			5
			6
			7

Mental Models

Mental model construct domains were identified from the literature. Some of the items were taken from previously developed scales, others were taken from items theorized in the literature. Appendix B lists these items and their sources. Each of these constructs will be investigated below.

Time Orientation. As previously discussed, time orientation is defined as the perceived importance of timely response to the environment. Time orientation was posited to be a multidimensional construct consisting of six items taken from the literature. The six components for this construct (and abbreviated variable names for further reference in this study) are outlined in below.

- A1) In making decisions, it is more important to consider short term effects rather than longer term effects.

- A2) It is important to respond quickly to the changing needs of the customer.
- A3) It is important to get new products out, even if they have not been technically refined.
- A4) It is important to respond very quickly to changes made by competitors.
- A5) Technical people are generally too slow to respond to competitive threats.
- A6) It is important to have patent protection, even if this takes a long time to obtain.

Marketing Information. Use of market information is defined as the importance placed by the individual on marketing's information gathering such as formal marketing research, and/or the type of information provided by the marketing core to the technical core. Use of market information was posited to be a multidimensional construct consisting of eight items taken from the literature. These eight components for this construct (and abbreviated variable names for further reference in this study) are outlined below.

- A7) Formal marketing research (concept testing, product prototypes, market tests) is the best way to obtain information from customers on new product needs.
- A8) The use of formal marketing research is more important for established products than new products.
- A9) The use of less formalized marketing research (eg focus groups, interviews) is the best way to obtain information on customer's needs.
- A10) Marketing research is the best source of information on new products that meet customer's needs.
- A11) Information provided by marketing people does not always focus on customer's real needs.
- A12) Most marketers are not technically sophisticated.

- A13) Marketing information is biased to marketing's short term interests.
- A14) Marketing people are more interested in immediate customer behavior rather than long term customer needs.

Outcome Expectations. Outcome expectations is defined as which outcomes are prioritized by the individual for the firm. Outcome expectations was posited to be a multidimensional construct consisting of eleven items taken from the literature. The eleven components for this construct (and abbreviated variable names for further reference in this study) are outlined below.

- A15) It is more important to focus on forces that effect marketing rather than on technical forces.
- A16) The long term health of the firm is reflected by immediate sales and profits.
- A17) It is important to protect the profitability of existing products by countering competition with competitive new products.
- A18) The most important goal for a firm is to maximize sales.
- A19) Return on investment should be the main criteria for evaluating a new product alternative.
- A20) The long term health of the firm is derived from new technology and innovation.
- A21) The most important goal for a firm is to maximize market share.
- A22) Use of technology is the best way to find new approaches to new strategy and to achieve superior competitive positions.
- A23) It is important to achieve technical performance in new products even if this does not lead to immediate success for new products.
- A24) New technologies represent opportunities to meet needs that customers have not previously recognized.

A25) Patent protection from the production of technology can lead to long-term competitive advantages.

Role Expectations. Role expectations is defined as the role expectation held by individuals of others in the firm. Role expectations was posited to be a multidimensional construct consisting of seven items taken from the literature. The seven components for this construct (and abbreviated variable names for further reference in this study) are outlined below.

A26) Only marketers should identify customer's needs so the firm can react to customer's requests (through R&D).

A27) Technical personnel should identify customer's needs to help develop products which satisfy those needs.

A28) If a product can be made, it can be sold.

A29) Effective marketing (pushing a product) can give new products a competitive advantage.

A30) Marketing's role is to sell new products.

A31) Technological ideas should drive the marketing of new products.

A32) Marketing should be able to find commercial applications for new technology.

The mental models were measured on seven point Likert-type scales anchored by Strongly Agree and Strongly Disagree. Traditional scale development (Churchill 1979) procedures were employed including: factor analysis, coefficient alphas, and item-to-total correlations to assess the reliability of the items and constructs.

Global Validity Measures. Two global measures were used to assess the validity of the mental model measures. The global measures were based upon the idea sources

preferred to be used by constituency members. These measures have had a great deal of theoretical support.

The core of a market orientation resides in meeting the needs of the market. How each core in the new product development perceives how that focus should be undertaken is a point of contention between the marketing and technical cores. Given the differences in training and experience of the marketing and technical cores, it should be no surprise that the following perceptual differences occur.

Marketing Core. Part of marketing's role in the new product development process is to reduce the risk involved in introducing the new product (Moenaert and Souder 1990). The marketing core may undertake this by identifying problems or opportunities which arise from the company's specific strategy of serving a defined market and through the marketing core's interaction with the needs of that market (Conway and McGuinness 1986; Kamath, Mansour-Cole, and Apana 1993). The marketing core may believe that demand should precede and trigger product development and be the formulation of and set the funding for marketing strategies (Nyström 1985; Shanklin and Ryans 1987). They will likely feel that the technical core lacks a customer orientation and may produce what the technical core "thinks" the customer needs rather than listening to the customer (Gupta, Raj, Wilemon 1985; Reukert and Walker 1987).

Technical Core. The technical core may see their role as directed toward solving consumer problems (Bruce and Rodgus 1991) through preemptive R&D and product development (Urban and Hauser 1993). Or they may have a new product

concept which is the result of a technological discovery or from the availability of a new technology (Conway and McGuinness 1986).

The two global validity variables will be measured on a seven point Likert-type scale. Global validity item #1 will be reversed scored to maintain the direction of item #2. The global validity items were correlated with each mental model sub-scale to assess the validity of the sub-scale items and evaluate their inclusion in the scale.

- 1) Marketing plays a major role in reducing the risk of introducing a new product. (Reversed)
- 2) The best source of new product ideas comes from R&D and product development.

Education/Training Background

Numerous authors have cited education and training as primary antecedents to the development of mental models (Gupta, Raj, and Wilemon's 1986; Gupta and Rogers 1991; Kelly 1955; Maidique 1984; McNulty and Whittington 1992; Pavia 1991; Rogers 1983; Rogers and Rogers 1976; Shanklin and Ryans 1987; Urban and Hauser 1993; Weinrauch and Anderson 1982). An individual's education is likely to exist across levels (bachelors, masters, doctoral) and is likely to be cross trained (e.g. engineering undergraduate with masters in business, or post employment training). The respondents' self-reported educational and training background was used to assign non-technical, mixed, and technical groups in order to determine differences in each group's mental model. The question format for assessing educational background and the total number of respondents for each cell is found in Chapter 4.

Each respondent could check more than one box. Respondents were placed into three groups (see Table 2). Individuals with a science/technical backgrounds only were placed into a technical group. Those who had a combination of technical with business or other education were placed into a mixed group. Individuals with only a business background were placed into a business group. Those who could not be clearly classified were placed into an "other" group.

Validity Measure. To assess the validity of the educational background, a single item measured the individual's self report of their marketing versus technical orientation. An ANOVA using the above groups against the self report measure give an indication of the validity of the grouping.

Experience. One question measured the respondent's experience with new product development teams. This question was measured as a seven point semantic differential question anchored by Little experience with and a Great deal of experience with new product development teams.

Cross functional experience was measured using a multi item scale. Questions were developed to assess cross functional experience beyond new product develop teams. Table 6 outlines the cross functional experience items.

TABLE 4

CROSS FUNCTIONAL EXPERIENCE ITEMS

Instructions: As you consider your business career in this organization as well as others, please indicate your agreement with the following statements:

- a) I have had a large number of job assignments across functional areas.
 - b) I have participated on a large number of cross-functional teams.
 - c) I have participated in a large number of management training programs.
 - d) I have trained myself in many different aspects of business operations.
 - e) I often participate, both formally and informally, on projects with people from other functional areas within the business.
 - f) I often interact, both formally and informally, with customers.
-

All of the cross functional items were analyzed using coefficient alpha.

Data Analysis

This study set out to determine the relationship between constituency core members' mental models and their new product development choices. To determine these relationships, this study had two objectives:

1. Develop measures of the mental model, antecedent, and product choice constructs.
2. Empirically examine the posited specific relationships between the antecedent factors, the mental models constructs, and the resulting new product development alternative preference.

To meet the first objective, scales have been developed to tap each construct domain. To meet the second objective, hypotheses have been proposed that posit specific relationships between the antecedent factors, new product preferences, and the mental model items.

The next chapter will use traditional scale development techniques to analyze the above measures. The refinement of these measures followed Churchill's (1979)

recommendations for effective development of constructs. Hypotheses were investigated through the use of univariate, multivariate, and multiple regression statistical techniques. The data for these analyses consist of the results of a field survey as outlined in this study.

CHAPTER IV

RESEARCH FINDINGS

The primary focus of this study was to determine the nature of the mental models that new product development team members hold and to examine their origins and decision-making implications. This chapter outlines the findings from the elicitation and specification of these mental model constructs. Churchill's (1979) multi-step process for the development of reliable and valid measures was the major paradigm used for the identification of the mental model constructs. This analysis will be followed by the testing of hypotheses regarding the constructs.

Descriptive Statistics

In order to design the mental model scales and test hypotheses, it was critical to obtain a sampling frame from individuals with marketing, mixed, and technical backgrounds. Table 5 summarizes the educational background characteristics of the subjects. As can be seen, a wide representation of educational backgrounds are represented. The total listings exceeds the respondent pool of 193 since many individuals have multiple degrees.

TABLE 5

RESPONDENT EDUCATIONAL BACKGROUND

Education:	Bachelor's	Graduate	Post Graduate
Science/Technology - Engineering	62	25	15
Business: Non-Marketing	22	28	5
Business: Marketing	6	24	8
Social Science/Liberal Arts	20	4	2
Other: (Please indicate:)	5	3	3

Educational Groupings:	
<u>Background</u>	<u>Number</u>
Technical	78
Mixed	52
Business	38

Each individual was placed into a category based upon his or her reported educational background. Technical individuals had predominantly technical education. Marketing individuals had predominantly business education. Mixed individuals had combinations of technical and business education (typically the mixed individuals have undergraduate technical and graduate business education).

Table 6 outlines the representativeness of the businesses in which the respondents currently work. The sample is strongly represented by manufacturing (55.9%). However, it also has representation from other business types and service organizations.

TABLE 6

SUMMARY OF SIC CODE CHARACTERISTICS OF SAMPLED FIRMS

<u>Industry</u>	<u>Count</u>	<u>Percent</u>	<u>SIC Codes</u>
Agriculture	1	.5%	01-09
Mining	2	1 %	10-14
Contractors/Construction	11	5.7%	15-17
Manufacturing	108	55.9%	20-39
Communication, Transportation & Utilities	5	2.3%	40-49
Wholesalers	1	.5%	50-51
Retailers	4	2.1%	52-59
Finance, Insurance & Real Estate	4	2.1%	60-67
Services	45	23.3%	70-89
Non Respondents	13	6.7%	

Table 7 indicates the diversity in business sizes. There was a strong representation from all business sizes.

TABLE 7

SUMMARY OF SIZE CHARACTERISTICS OF SAMPLED FIRMS

<u>Employee Size</u>	<u>Number of Business Units</u>	<u>Percent</u>
1-99	37	19.2%
100-249	34	17.6%
250-499	31	16.0%
500-999	35	18.1%
1000 +	42	21.8%
Unreported	14	7.3%

Scale Development

Scale Analysis Methods

As recommended by Churchill (1979), factor analysis is used as a purification method. The use of factor analysis allows the identification of the underlying dimensions of the mental models held by individuals by determining the patterns of relationships (Hair et al. 1992; Kim and Mueller 1978). In addition, this further reduces the total number of scale items representing each mental model construct.

Principal Components Factor Analysis. To reduce the initial number of items for each construct within the scale, a principal components factor analysis was run on each *a priori* mental structure outlined in Chapter 3. Principal component factor analysis provides for a linear combination of the observed variables such that it accounts for the maximum variance. This captures all of the variance but does not assume that a model exists (Stewart 1981).

Criteria for the evaluation of the factor structures as outlined by Hair et al. (1992) were followed in the initial analysis. An eigenvalue cutoff criteria of 1.0 was set for each mental model construct. Each construct item was required to be loaded at the .5 or above level and must not have cross loaded heavily with other factors. In addition, each resulting factor must relate to the theory base upon which the study was developed.

Coefficient Alpha. To assess the internal reliability of the factors theorized to pertain to each mental model construct, item-to-total correlations and Cronbach's alpha (1951) were calculated for every item in the factor representing the mental model

dimension. As recommended by Churchill (1979), the use of item-to-totals and Cronbach's alpha (1951) should be utilized in the development of scales. By analyzing the item-to-total and alpha scores, the items which do not share a common factor can be deleted, improving the interpretability and reliability estimates for the scale. Churchill's (1979) recommendations for maintaining items in a scale are dependent upon the type of analysis undertaken by the researcher with the overall alpha of .5 for exploratory levels, .8 for marketing measures at, and .9 for managerial measures at.

Validity Assessment. Two validity measures designed to assess the convergent validity of the mental model constructs were included in the questionnaire. The constructs should have a significant correlation with the global validity item. These items are:

1. Marketing plays a major role in reducing the risk of introducing a new product. (Reversed Scored)
2. The best source of new product ideas comes from R&D and product development.

Analysis of the Time Construct

The initial Time mental model construct consisted of six items, A1 - A6. The principal component factor analysis resulted in a three factor solution. Two of the factors consisted of two items each, and the third was a single item factor. One item (A5) did not meet the .5 loading criteria and was dropped.

A second principal component factor analysis on the remaining five items resulted in a three factor solution. Two of the factors consisted of two items each, and the third was a single item factor.

An analysis of the resulting factors indicated that only the two-item Factor 1 strongly represented the theory base (Hair et al. 1992) for the mental model construct. Thus, Factors 2 (A2, A4) and 3 (A6) were dropped from further consideration.

The two items included in Factor 1 were rerun in a principal components factor analysis which resulted in a single factor solution meeting the eigenvalue criteria of 1.0. The results are indicated in Table 8.

TABLE 8
TIME MENTAL MODEL CONSTRUCT FACTOR LOADINGS
AND ALPHA ANALYSIS

Survey Item Number	Mental Model Construct Item	Factor Loadings	Alpha: .44	Item To Total
A1	In making decisions, it is more important to consider short term effects rather than longer term effects.	.793		.288
A3	It is important to get new products out, even if they have not been technically refined.	.793		.288
Eigen Value		1.26		
Percent of Variance		62.9%		

The coefficient alpha of .44 for Time is below the minimum cutoff set by Churchill (1979). Likewise, both item-to-total correlations are quite low. But as this is an exploratory study and hypotheses concerning time were in the initial analysis, the construct will be retained for further investigation.

Validity analysis indicated that the Time construct was not significantly correlated with the global validity item #1 ($r = .018, p < .802$) or item #2 ($r = .007, p < .920$). However, given the importance of Time in the literature, this construct will be retained for further analysis.

Analysis of the Marketing Information Construct

The initial Marketing Information mental model construct consisted of eight items A7 - A14. The principal component factor analysis resulted in a three factor solution with the first factor including four items. The second and third factors included two items each. No items were dropped due to low loadings.

An analysis of the three factors indicated that only the four-item Factor 1 strongly represented the theory base (Hair et al. 1992) for the mental model construct. Factors 2 (A7, A8) and 3 (A9, A10) were dropped.

The four items included in Factor 1 were included in a principal components factor analysis which resulted in a single factor solution meeting the eigenvalue criteria of 1.0. The results are indicated in Table 9.

TABLE 9

MARKETING INFORMATION MENTAL MODEL CONSTRUCT
FACTOR LOADINGS AND ALPHA ANALYSIS

Survey Item Number	Mental Model Construct Item	Factor Loadings	Alpha: .81	Item To Total
A11	Information provided by marketing people does not always focus on customer's real needs.	.739		.553
A12	Most marketers are not technically sophisticated.	.768		.601
A13	Marketing information is biased to marketing's short term interests.	.824		.656
A14	Marketing people are more interested in immediate customer behavior rather than long term customer needs.	.850		.696
		Eigenvalue	2.54	
		Percent of Variance	63.4	

The coefficient alpha of .81 for Marketing Information is well within Churchill's (1979) marketing levels. Further, all items correlate strongly with the scale total.

Validity analysis indicated that the Marketing Information construct was significantly correlated with the global validity item #1 ($r = .300, p < .001$) and item #2 ($r = .200, p < .05$).

Analysis of the Outcome Expectations Construct

The initial Marketing Information mental model construct consisted of eleven items A15 - A25. A principal component factor analysis resulted in a four factor solution. The first factor included three items, the remaining three factors included two items each. Two items were dropped due to low loadings (A17, A25) on any factors.

A second principal component factor analysis was run on the remaining nine items resulting in a four factor solution. The first and second factors included three items each, the third factor contained two items, and the fourth factor included one item.

An analysis of the results indicated that two factors fit the theory base with each factor tapping a unique domain. One factor (A20, A22, and A24) relates to a technical perspective on new product development. This factor was retained and called the Technical Approach. Another factor (A16, A18, and A21) relates to a marketing perspective. This construct will be called Marketing Outcomes. Each of these factors will be considered as separate constructs for further analysis. This will result in the splitting of hypothesis H1c into H1c1 and H1c2. The two item Factor 3 and the single item Factor 4 did not represent the theory base (Hair et al. 1992) for the mental model construct and were dropped.

The six items included in Factors 1 and 2 were rerun in a principal components factor analysis which resulted in a two factor solution meeting the eigenvalue criteria of 1.0. The results are indicated in Table 10.

TABLE 10

OUTCOME EXPECTATIONS MENTAL MODEL CONSTRUCT
FACTOR LOADINGS AND ALPHA ANALYSIS

Survey Item Number	Mental Model Construct Item	Loadings Factor		Alpha:	Item To Total
		1	2		
	TECHNICAL APPROACH			.59	
A20)	The long term health of the firm is derived from new technology and innovation.	.760			.386
A22)	Use of technology is the best way to find new approaches to new strategy and to achieve superior competitive positions.	.750			.496
A24)	New technologies represent opportunities to meet needs that customers have not previously recognized.	.683			.307
	MARKETING OUTCOMES			.58	
A16)	The long term health of the firm is reflected by immediate sales and profits.		.795		.370
A18)	The most important goal for a firm is to maximize sales.		.715		.438
A21)	The most important goal for a firm is to maximize market share.		.653		.349
	Eigen Value	1.86	1.49		
	Percent of Variance	28.1%	27.8%		
	Cumulative Variance	28.1%	55.9%		

The coefficient alphas for both the Technical Approach and Marketing Outcomes scale are well within Churchill's (1979) exploratory levels at .59 and .58 respectively. Validity analysis indicated the Technical Approach construct was significantly correlated with the global validity item #1 ($r = -.163, p < .05$) and item #2 ($r = .198, p < .05$). The Marketing Outcomes construct was not significantly correlated with the global validity item #1 ($r = .018, p < .80$) and significant only at the .1 level for item #2 ($r = .119, p < .10$).

However, this construct has been deemed important in the literature and will be retained for further analysis.

Analysis of the Role Expectations Construct

The initial Role Expectations mental model construct consisted of seven items (A26 - A32). The initial principal component factor analysis resulted in a two factor solution with the first factor including four items. The second factor included two items. One item was dropped due to low loadings (A29) on the factors.

A second principal component factor analysis was run on the remaining six items which resulted in a two factor solution. The first factor included four items. The second factor included two items. An analysis of the resulting factors indicated that only the four-item Factor 1 strongly represented the theory base (Hair et al. 1992) for the mental model construct. Factors 2 (A26, A27) was dropped.

The four items included in Factor 1 were rerun in a principal components factor analysis which resulted in a single factor solution meeting the eigenvalue criteria of 1.0. The results are indicated in Table 11.

TABLE 11

ROLE EXPECTATIONS MENTAL MODEL CONSTRUCT
FACTOR LOADINGS AND ALPHA ANALYSIS

Survey Item Number	Mental Model Construct Item	Factor Loadings	Alpha: .65	Item To Total
A28	If a product can be made, it can be sold.	.621		.363
A30	Marketing's role is to sell new products.	.694		.416
A31	Technological ideas should drive the marketing of new products.	.743		.482
A32	Marketing should be able to find commercial applications for new technology.	.718		.453
Eigenvalue		1.934		
Percent of Variance		48.4%		

The coefficient alpha for Marketing Information is well within Churchill's (1979) marketing levels at .65. However, the item-to-total correlations are low. Validity analysis indicated that the Role Expectations construct was significantly correlated with the global validity item #1 ($r = .151, p < .05$) and item #2 ($r = .381, p < .001$). The following briefly summarizes the constructs retained for hypothesis testing.

Time. The Time measure consists of two items. Each item has high factor loading, but the coefficient alpha was .44 which is below Churchill's (1979) exploratory measures. In addition, the Time measure had low correlations with the validity items. The two items do seem to represent the individual's beliefs about immediate time response. Given the importance placed upon response time in the current literature, these measures will be included for further analysis, but the weaknesses in the measure must be considered when looking at the results.

Marketing Information. The Marketing Information (Mktg-Info) factor indicates perceptions of marketing's role in providing information to the new product development process. The belief is that information provided by marketing people does not focus on customer's real needs. Most marketing people would not be seen as technically sophisticated. Marketing's information would be biased toward marketing's short term interests, and marketing people would be seen as being more interested in immediate customer behavior rather than long term customer needs.

The measure seems to have both reliability and validity. Each of the four items has a high factor loading (at least .739) and the coefficient alpha is .81. In addition, the Mktg-Info measure has high and significant correlations with the validity items.

Technical Approach. The Technical Approach (Tech-App) factor includes items related to the technical aspects of new product introduction. This construct focuses on the belief that the long term health of the firm is derived from new technology and innovation and that the use of technology is the best way to find new approaches to strategy and to achieve superior competitive positions. These new technologies would represent opportunities to meet needs that customers have not previously recognized.

The measure seems to both reliable and valid. Each of the three items has a high factor loading (at least .683) and the coefficient alpha is .59. In addition, the Tech-App. measure has high and significant correlations with the validity items.

Marketing Outcomes. The Marketing Outcomes (Mktg-Out) measure is clearly related to the outcome expectations using traditional business criteria. These beliefs

focus on how the long term health of the firm is reflected by immediate sales and profits.

The most important goal for a firm is to maximize sales and market share.

Each of the three items has a high factor loading (at least .653) and the coefficient alpha is .58. The correlations with the validity items were weak. Validity item 1 was not significant while item 2 was significant at only the .1 level.

The Mktg-Out measure would indicate that the stronger the respondents agreement with the mental model construct, the stronger the belief in the importance of the outcome measures. The directional relationship for of this measure is opposite from the other measures which are more oriented toward innovation. For hypothesis testing, the Mktg-Out measure will be reversed to maintain the same direction towards innovation.

Role. The Role measure includes the role of marketing people in the new product development process, but in addition includes items related to the perceptions of chances of new product success. This belief holds that if a product can be made, it can be sold (Say's Law) and marketing's role is to sell new products. This is perhaps because technological ideas are seen as driving the marketing of new products. Given this, marketing should be able to find customer markets for new technology.

The measure seems to both reliable and valid. Each of the four items has a high factor loading (at least .621) and the coefficient alpha is .65. In addition, the Role measure had high and significant correlations with the validity items.

TABLE 12
DESCRIPTIVE STATISTICS FOR MENTAL MODEL ITEMS

	Number of Items	Mean Scores	s.d.	Range	Min.	Max.
TIME	2	5.20	1.18	6	1	7
MKTG-INFO	4	4.27	1.22	6	1	7
TECH-APP	3	5.27	0.85	5	2	7
MKTG-OUT	3	4.77	1.09	5	2	7
ROLE	4	3.38	1.00	5	1	6

Descriptive statistics for each mental model construct measure are indicated in Table 12. A higher level mean score indicates a greater level of agreement with the construct. The Role measure is the lowest measure with a mean score of 3.38. The technical approach construct (Tech-App) has the highest mean of 5.27 on a seven point scale. The high indication of agreement for the scale could be due to the nature of the sampled population. Of those who reported their educational background, 46% reported technical backgrounds and 78% reported technical or mixed backgrounds.

New Product Preferences (IDEA)

Product innovation choice is measured as varying on a spectrum from a continuous innovation to a discontinuous innovation (Meyer and Roberts 1986; Nyström 1985). This has been assessed based on two dimensions: technology innovation and behavioral change innovation. Each is measured on a 7-point scale that assesses the respondent's preferences for involvement in such a new product innovation. Position 1

on the scale indicates preference for no "change" while Position 7 indicates preferences for a discontinuous innovation. The mean scores for each item are provided in Table 13. The preference among respondents is for more discontinuous innovation.

TABLE 13
PREFERENCES FOR DISCONTINUOUS INNOVATIONS MEASURES

	Mean Score	Standard Deviation
Technical Change	5.80	1.61
Behavioral Change	4.50	1.14

The behavioral change and technical change items were significantly correlated ($r = .43, p < .001$). The significant correlation between the two items indicate that the two represent a singular domain of new product preferences. The two items were averaged for each individual to create the Idea construct used to test the hypothesis which follow.

Antecedent Factors

A number of antecedent factors were assessed for their influence on mental models. Educational training and cross functional experience measures were obtained from the respondents.

Post High School Education/Training. The respondents were placed into four groups based upon their reported education/training. The group's raw numbers and percentage of total for the groups were reported in Table 5. As explained, technical individuals had predominantly technical education. Marketing individuals had

predominantly business education. Mixed individuals had combinations of technical and business education (typically the mixed individuals have undergraduate technical and graduate business education).

To assess the validity of the educational/training groupings, a single item measure was used to determine if they differed in their self assessments of their market vs technical orientation. Those with business backgrounds should declare a market orientation. Those who have technical backgrounds should be more technically oriented. Those who have mixed backgrounds should rate themselves between the business groups and the technical groups.

An ANOVA analysis was used to assess the validity of the education categorizations derived for the three groups. The results are indicated in Table 14.

TABLE 14
ANOVA ANALYSIS OF GROUP VALIDITY
EDUCATION AND TRAINING BACKGROUND VALIDITY MEASUREMENT

Business (B)	Means (Standard Error)		Tukey HSD Comparison of probability Differences ($p < $)		
	Mixed (X)	Technical (T)	B - X	X - T	B - T
3.33 (.221)	4.55 (.192)	5.33 (.161)	.000	.005	.000

$F = 26.98, p < .000.$

The results indicate that the a priori grouping successfully placed individuals into a business, technical, and mixed group ($p < .000$). Further, as anticipated, the self-assessments of marketing versus technical orientation increased with technical training.

Further, a planned-comparison of means indicated differences between each pair of groups.

Experience. Two measures of business experience were utilized. One was a single item measure of new product development team experience ($x = 5.22$). A second measure was a multi-item scale evaluating the level of cross training the individual has in the business. The level of cross training of the respondent was assessed using a six item, Likert-type measure with high scores indicating extensive experience. To assess the internal reliability of the items, Cronbach's alpha (1951) and item-to-total correlations were used.

After running an initial alpha analysis, one item (C3F) was removed from the cross functional scale due to its low item-to-total correlation. A final alpha was then determined for the remaining five items. Table 15 outlines the results of the item reduction analysis. The alpha of .75 indicates that the measure did meet Churchill's (1979) criteria for exploratory measures. The mean for the measure is 5.22.

TABLE 15

ITEM-TO-TOTAL CORRELATIONS AND ALPHA
STATISTICS FOR BUSINESS CROSS FUNCTIONAL EXPERIENCE

Survey Item	GLOBAL VALIDITY CONSTRUCT ITEMS	ALPHA	ITEM-TOTAL CORRELATIO N.
	<u>BUSINESS EXPERIENCE</u>	.75	
C3A)	I have had a large number of job assignments across business areas.		.468
C3B)	I have participated on a large number of cross-functional teams.		.589
C3C)	I have participated in a large number of management training programs.		.480
C3D)	I have trained myself in different aspects of business operations.		.495
C3E)	I often participate, both formally and informally, on projects with people from other functional areas within the business.		.591

Correlation Table

Table 16 provides a correlation matrix of the mental model variables, product preference, metric antecedent variables, and organizational context variables. In general the results of the correlation analysis are supportive of the results reported later.

TABLE 16

CORRELATION TABLE

	TIME	MKTG -INFO	TECH -APP	MKTG -OUT	ROLE	IDEA	NPD -EXP	CROSS -EXP
TIME	-							
MKTG-INFO	-.080	-						
TECH-APP	.030	.195 ^b	-					
MKTG-OUT	.076	-.030	-.111	-				
ROLE	.234 ^a	.234 ^a	.165 ^b	-.191 ^b	-			
IDEA	.040	.027	.173 ^b	.004	.016	-		
NPD-EXP	-.131 ^c	-.063	-.030	.040	-.231 ^a	-.044	-	
CROSS-EXP	.040	-.085	.057	.066	-.020	-.028	.008	-

^a Significance @ .001 Level

^b Significance @ .05 Level

^c Significance @ .10 Level

HYPOTHESES TESTING

Based upon the proposed relationships outlined in this study, a number of hypotheses were tested. These included relationships among various antecedent variables, mental models, and new product preference orientations. Each hypothesis is discussed separately below.

Mental Model and Product Preference Hypotheses

In the alternative hypothesis form, the relationships between the mental model constructs and the new product preferences are stated below.

H1a: The Time mental model construct will be positively related to the individual's preference for discontinuous innovation.

H1b: The Use of market information mental model construct will be positively related to the individual's preference for discontinuous innovation.

H1c1: The Technical Approach mental model construct will be positively related to the individual's preference for discontinuous innovation.

H1c2: The Marketing Outcomes mental model construct will be positively related to the individual's preference for discontinuous innovation.

H1d: The Role expectations mental model construct will be positively related to the individual's preference for discontinuous innovation.

TABLE 17

MULTIPLE REGRESSION ANALYSIS OF
RELATIONSHIP BETWEEN MENTAL MODEL CONSTRUCTS
AND NEW PRODUCT PREFERENCES

Variable	Expected Sign for H1	Parameter Estimate	Standard Error	t	Prob. t
Constant		3.682	0.800	4.602	0.000
Time	+	0.036	0.075	0.484	0.629
Marketing Information	+	-0.001	0.073	-0.009	0.993
Technical Approach	+	0.241	0.102	2.371	0.019
Marketing Outcomes	+	0.019	0.018	0.237	0.813
Role	+	-0.021	-0.018	-0.227	0.821
Model F	=	1.220			
Prob. F	=	0.301			
R ²	=	0.032			
Adjusted R ²	=	0.006			

The proposed relationships were tested using multiple regression as shown in Table 17. There appears to be no significant multivariate relationship between the new product preference variable and the mental model constructs ($F=1.22, p<.301$). These results indicate rejection of the alternative hypotheses H1a - H1d at the multivariate level.

Based on the statistical significant beta coefficients for the Technical Approach, a simple regression was run including Technical Approach mental model and new product preference. The results are indicated in Table 18 below.

TABLE 18

SIMPLE REGRESSION ANALYSIS OF
RELATIONSHIP BETWEEN TECHNICAL APPROACH
MENTAL MODEL CONSTRUCT AND NEW PRODUCT PREFERENCES

Variable	Expected Sign for H1	Parameter Estimate	Standard Error	t	Prob. t
Constant		3.916	0.521	7.520	0.000
Technical Approach	+	0.236	0.098	2.418	0.017
Model F	=	5.846			
Prob. F	=	0.017			
R ²	=	0.030			
Adjusted R ²	=	0.025			

The simple regression results indicate that a significant positive relationship exists between the Technical Approach held by the individual (beliefs that the long term health of the firm is derived from new technology and innovation) and the preference for a more discontinuous new product ideas ($F=5.85, p<.017$). This is supportive of hypothesis H1c1.

The model R square was .03. However, Rouse and Morris (1986) have theorized that a low R square from the regression model can be expected due to the dynamic nature of mental models and the lack of likelihood that a "true" mental model can be identified.

The failure of the other mental model constructs to explain product preference is surprising. However, this could be due to the discontinuous new product preferences being made without reference to any "real" world restrictions. Mental model constructs are theorized to develop from actual experience and may be related to the more "real" product choice.

Antecedent Factors

Antecedent factors considered in explaining the mental models were individual's education/training background and the individual's level of new product experience.

Each will be described below as it relates to the mental model.

Education/Training Background. Stated in the alternative hypothesis form, the relationship between the education/training background of the individual and the mental model constructs is:

H2: There will be significant differences in the mental model measures between individuals with differing educational/training backgrounds.

Given that theory states that one's education and training can lead to the development of mental models, it follows that the type of college degree, if any, or any additional on-the-job training could affect the mental model held by that individual.

To test the proposed relationships, an ANOVA was run for each mental model construct against the educational groups (technical, mixed, and business). A summary of the results is shown in Table 19.

TABLE 19

SUMMARY OF ANOVA RESULTS FOR MENTAL MODEL CONSTRUCTS
AGAINST EDUCATIONAL/TRAINING BACKGROUND

Mental Model Variable	Means (Standard Error)			Model Significance		Tukey HSD Comparison of Probability Differences*		
	B	X	T	F =	<i>p</i> <	B - X	X - T	B - T
Time	5.156 (.174)	4.991 (.153)	5.273 (.133)	0.960	.385	.759	.348	.854
Marketing Info	3.725 (.192)	4.454 (.165)	4.477 (.140)	5.725	.004	.011	.994	.004
Technical App	5.000 (.132)	5.377 (.114)	5.342 (.096)	2.815	.063	.078	.971	.091
Marketing Out	4.704 (.161)	4.822 (.142)	4.792 (.123)	0.161	.851	.846	.986	.900
Role	3.244 (.155)	3.255 (.133)	3.510 (.113)	1.411	.233	.998	.310	.347

* Unequal sample sizes were adjusted by a harmonic mean *n*, Tukey-Kramer adjustment (Wilkinson 1990).

The results indicate that one mental model construct, Mktg-Info, differs significantly between groups at the .05 level of significance ($F=5.725, p<.004$). In addition, Tech-App differs significantly between groups at the .10 level of significance ($F=2.815, p<.063$). These results are supportive of hypothesis H2.

The Tukey HSD comparison of probability differences indicate that for the Marketing Information mental model construct the Business group was significantly different from the Mixed group at the .05 level of significance ($p<.011$). Further, the Business group was also significantly different from the Technical group at the .05 level of significance ($p<.004$). The only other statistically different groups were for Technical Approach although the differences were weak ($p<.10$).

Although few results were statistically significant, the means for the groups are in the expected direction. Those with a technical background were more likely to agree with the technical direction in mental model constructs. For example, the Marketing Information mental model construct indicates that the higher the mean score, the less reliance would be placed upon marketing information. For the Technical Approach mental model construct, the higher the mean score, the greater will be the reliance placed upon technical solutions.

Experience. Stated in the alternative hypothesis form, the relationships between the new product development team experience construct and the mental models is:

H3a: The greater the level of new product experience, the weaker the technical orientation of the mental model belief resulting in a negative relationship between the level of new product experience and the mental model construct.

Theory states that the greater the amount of cross-functional experience an individual holds, the more likely they are to moderate their mental models, it follows that there will be a significant negative relationship between the individual's mental model and the level of cross-functional experience. To assess the relationship between new product development team experience and the mental models simple correlation analysis was run. Table 20 indicates the results.

TABLE 20

CORRELATION ANALYSIS OF MENTAL MODEL CONSTRUCTS
AND NEW PRODUCT DEVELOPMENT TEAM EXPERIENCE

	TIME	MKTG -INFO	TECH -APP	MKTG -OUT	ROLE
NPD-EXP	-.131 ^c	-.063	-.030	.040	-.231 ^a

^a Significance @ .001 Level

^b Significance @ .05 Level

^c Significance @ .10 Level

The results indicate that new product development team experience does have a significant negative relationship to Role Expectations ($r = -.231, p < .001$) and has a significant negative relationship to Time at the .1 level ($r = -.131, p < .10$). This is supportive of H3a. In addition the sign of the other correlations is in the expected direction except for Mktg-Out. The mental models scales measure an intensity of a belief held by an individual. The negative relationship indicates that the greater the level of new product team experience, the less strongly held the individual's beliefs about the marketer's role expectations and immediate time response.

Stated in the alternative hypothesis form, the relationships between the cross functional team experience construct and the mental models is:

H3b: The greater the level of cross functional experience, the weaker the technical orientation of the mental model belief resulting in a negative relationship between the level of cross functional experience and the mental model construct.

To assess the relationship between cross functional experience and the mental models, simple correlation analysis was run. Table 21 indicates the results.

TABLE 21

CORRELATION ANALYSIS OF MENTAL MODEL CONSTRUCTS
AND CROSS FUNCTIONAL EXPERIENCE

	TIME	MKTG -INFO	TECH -APP	MKTG -OUT	ROLE
CROSS-EXP	.040	-.085	.057	.066	-.020

The results indicate lack of support for H3b. While no significant relationships were found, the negative correlations for Marketing Information and Role Expectations indicate that the sign of the relationships between these two mental model constructs is as expected. This indicates that the greater the level of cross-functional experience, the less likely individuals are to agree with these two mental model constructs.

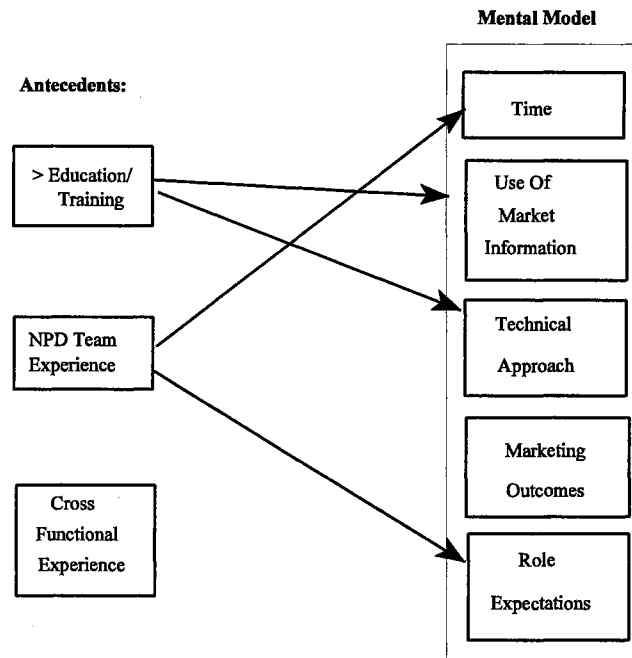
Summary of Research Findings

The empirical results of this study were designed to meet three objectives. The first was to determine the nature of the new product development mental model constructs held by individuals engaged in the new product development process. The results indicate that four constructs exist.

The second objective of this study was to determine if mental model constructs held by individuals engaged in new product development differ across antecedents factors. Figure 6 indicates the nature of those relationships.

FIGURE 6

SIGNIFICANT RELATIONSHIP BETWEEN ANTECEDENT FACTORS
AND MENTAL MODEL CONSTRUCTS

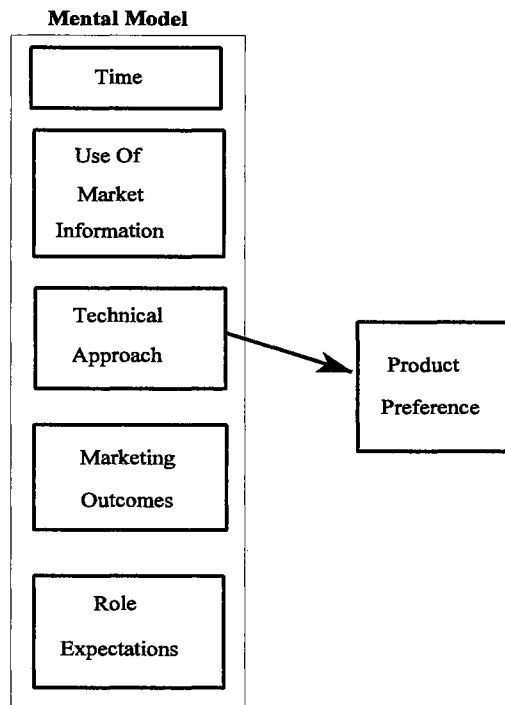


As shown, the two mental model constructs which indicate significant differences are Technical Approach and the Use of Market Information. In addition there is a significant negative correlation between NPD team experience and Role Expectations and between NPD team experience and Time.

The third objective was to determine if the mental model constructs were related to new product preference. The results are indicated in Figure 7. The results indicate that a single mental model construct, Technical approach is significantly correlated to the product preference.

FIGURE 7

TEST OF HYPOTHESES H1a - H1d



Taking a global perspective, there does appear to be antecedents which lead to mental models held by the individuals. In addition, one mental model construct is related to the type of new product preference chosen by the individual and the sign of the findings are supportive of hypothesized directions.

CHAPTER V

DISCUSSION AND IMPLICATIONS

The discussion of this study is in three parts. First, the supporting literature is reviewed, followed by a discussion of the methodology utilized in the study. Second, the research findings are reviewed and the implications for researchers and practitioners are developed. Finally, limitations of the study and recommendations for future research are presented.

Overview of Supporting Literature

The main purpose of this study was to assess the relationship between constituency core members' mental models, antecedent factors, and their new product development preferences. In order to understand these relationships this study operationalized each of the four mentioned constructs.

The potential for utilizing mental model constructs in understanding the new product development process has been proposed by researchers (Frankwick et al 1994; McKee 1992; Moenaert, Deschoolmeester, De Meyer, and Sounder 1992; and Reukert and Walker 1987b). In addition scholars have called for research on how individuals use and evaluate information in the new product development process (Aaby and Discenza

1993; Gupta and Rogers 1991; Kim 1993; McKee 1992; Meyers and Wilemon 1989; Sinkula 1994).

Currently there is consensus that a strong interface between marketing and research & development can lead to greater chances of new product development success (Aaby and Discenza 1993; Cooper 1984; Crawford 1991b; Drucker 1988; Gupta and Rogers 1991; Hise, O'Neal, Parasuraman, and McNeal 1990). This has led scholars to call for firms to adopt a "dual-drive concept of product innovation" to build upon the strengths of both marketing and R&D (Aaby and Discenza 1993; Crawford 1991a; Lucas and Bush 1988; Nyström 1985).

In order to enhance the possibility of harmonious relationships between these two constituency cores, the numerous barriers which hinder the marketing-R&D interface must be overcome. The most significant of these barriers have been found to be lack of communication, insensitivity to others' points of view, and little trust of others' information (Gupta, Raj, and Wilemon 1985; Gupta and Rogers 1991; Gupta and Wilemon 1988; 1990; 1991; Moenaert and Souder 1990; Vesey 1991). This study adds to the field of knowledge by identifying the mental model frameworks held by the marketing and research and development cores within a firm and the bases for such mental models.

Summary of Findings

In order to determine the nature of the new product development mental models, three research objectives needed to be met. The first was the identification of the mental models held by individuals. The second was to determine the antecedent factors which

could lead to those mental models. The third was to determine if those mental models were related to new product preferences.

To meet the first objective of identifying specific mental model constructs, it was necessary to identify the nature of the individual new product development mental model constructs. From the literature, four mental model constructs were proposed. These were Time Orientation, Use of Market Information, Outcome Expectations, and Role Expectations.

To measure these constructs, 32 items were developed based upon the literature. A questionnaire containing these items, antecedent factors questions, discontinuous new product preferences, other contextual variables were mailed to 844 individuals engaged in new product development. An effective response rate of 22.9% was obtained.

After purification and validity analysis, five mental model constructs were selected as representative of the domain. Time, Role Expectation, and Use of Marketing Information were identified as theorized. Outcome Expectation was split into two domains, one representing Technical Approaches and the other representing Marketing Outcomes.

The second objective of this study was to empirically determine which antecedent factors influence the mental model constructs. Hypothesis H2 suggested that an individual's educational background could have an influence on the mental models that an individual holds. To test this proposition, individual's responded to a question which asked them to indicate their post-secondary educational level and area of specialization. This was coded into a business, mixed, and technical background. A

validity check indicated that the categorization did indicate one's business to technical orientation.

Support for this hypothesis was found for Use of Marketing Information and partial support for a Technical Approach. The more technically oriented the individual, the less they trusted marketing information and the more they valued technical approaches.

Hypothesis H3a and H3b investigated the influence of experience on the individual's mental model constructs. This was tested by investigating both the level of new product experience of the individual as well as the individual's cross functional organizational experience.

The results for H3a indicate that a significant relationship does exist for new product development team experience and Role Expectations and for Time. It must be noted, however, that the Time measure was not a strong measure. The coefficient alpha was low (.44) and the two item construct did not correlate with the validity measures. But given the interest in speed in the current literature, this measure was included in the analysis. The direction of signs for the coefficients of the mental model constructs and new product team experience were in the expected direction. This indicated that the greater the level of new product development team experience, the less likely the individual was to hold the extreme beliefs as indicated by the mental model construct items.

No significant relationship was found for cross functional experience and the mental model constructs. These two results indicate that new product experience is more

important than cross functional experience in mitigating the strength of at least two mental model beliefs.

The third objective was to determine if the mental model constructs were related to new product preferences as indicated by H1a - H1e. A significant relationship was found between a Technical Approach and the new product preference. It appears that one's technical approach does lead toward a more discontinuous product innovation preference. No significant multivariate relationship exists between the other mental model constructs and new product preference.

In summary, the empirical results of this study indicated that antecedent factors do influence specific mental models held by individuals engaged in the new product development process, specifically the Use of Market Information and the Role Expectations. It is possible that the effect of education is to influence the predisposition of the mental models held by the individual. New product development team experience, on the other hand, seems to modify the extremes in beliefs held by those with technical and business backgrounds for Role Expectations and possibly at Time orientation. Finally, the Technical Approach mental model relates to new product preference.

Implications

The findings from this study make contributions to both the theoretical and managerial fields of marketing.

Theoretical Implications

This study has implication for marketing theory in three areas: the marketing/R&D interface, marketing education, and organizational learning. It has been theorized that when individuals share constructs, or have similar frames of reference, they can communicate more effectively (Gupta and Rogers 1991; Rogers and Rogers 1976). In order to limit the problems of "bounded rationality" (Schwenk 1988; Simon 1957) and the use of selective perception and selective interpretation to understand complex events, individuals must understand and share the mental model constructs that they hold. This study has attempted to identify the specific areas of contention between the marketing and technical cores in the firm.

In addition, linkages have been made to the educational background of the individuals engaged in new product development. Much of marketing theory has evolved around instructing marketers how to identify the needs of the customer and how to represent the customer in the bargaining process (Anderson 1982). Yet it is specifically marketing's attempt to provide information on the customer which has been seen in the literature as the area of greatest contention.

The work of VonHippel (1986) could be of special benefit in this area. His concept of using lead users for gathering marketing research may give the technical core within the firm greater confidence in the research results.

Organizations are believed to learn through the accumulation of knowledge held by individuals as well as in the culture and records of the firm (Dodgson 1993; Kim 1993). It is clear that not only do individuals learn in the firm, but they bring

predispositions to the learning process as well (McKenna 1992). Identification of those predispositions should help give individuals a better perspective on their own biases, aiding in the learning process.

Managerial Implications

Re-education and re-training can give team members an understanding of their own and other's mental models. If team members understand the antecedent factors which lead to these mental models, they will have an expanded educational and training perspective which could lead to less narrowly constrained mental model perceptions and improved communication.

Organizational renewal requires that managers change their mental models (Kim 1993). Failure to reorganize an individual's mental model in the face of environmental change can lead to organizational decline (Barr, Stimpert, and Huff 1992). In order to facilitate this renewal, decision makers must first understand their currently held mental models. Ruekert and Walker (1987a) have noted that in the new product development process, a better understanding of the causal direction of mental models could provide insight to the influencing interactions between marketing and R&D departments. In addition, an understanding of an individual's mental model used in a new product development decision has been posited as necessary for devising training programs (Rouse and Morris 1986). Managers should increase the level of new product development team cross training given to team members. This is already practiced by Japanese firms and have been adopted by some American firms.

In new product development team interactions, members should concentrate first on the type and level of marketing information which would be acceptable to the team. As these internal coalitions interact over time, they can adapt themselves to the new product development process which can enhance efficiency and effectiveness (Anderson 1982; Day and Wensley 1983). This close integration of the technical core with marketing can sensitize technical core personnel to the actual and potential needs of the customers, allowing new product development teams to better meet customer's needs (Gold 1987). A close linkage between the technical core and the marketing core should lead to the sharing of personal constructs and speed the negotiation process leading to accelerated new product development and to greater chances of new product development success.

It should be noted that this study does not imply that one mental model is better than another. Each new product development project will have differing criteria for evaluation. The problem arises when individuals don't adjust their mental models to fit each new strategic situation.

Limitations

This study has several limitations. While the response rate of 22.9% is acceptable for organizational research, it does not insure that the results are generalizable to new product development activity in the population at large. This study did attempt to make the results as generalizable as possible by including firms from a large number of different industries.

A second limitation is in the use of field surveys to tap mental model beliefs. While a survey method has the advantages of tapping a large pool of respondents, some researchers prefer a more experiential approach to data gathering. Generally, time and resource constraints limit the researcher's ability to personally observe a large sample population to determine a cross-sectional new product development mental model.

Another limitation is scale validity. A number of mental model constructs were identified. However, the purification process led to somewhat severe reductions in the number of scale items per construct. Likewise, the scale for product development preferences was measured as hypothetical when actual product projects would be preferable to examine.

No causal ordering of mental model constructs, antecedent factors, or product choice was investigated. While it seems logical that antecedents would precede the mental model beliefs, both could be preceded by individual difference characteristics. In addition, new product development experience may not necessarily precede mental model changes. The results could be related to other factors such as general experience and/or age. To help explore this causal ordering, other methodologies could be used such as longitudinal research.

Finally, this study only looked at simple relationships. This type of research could be examined in greater complexity by using structured linear equation modeling.

Future Research

The present study aids in providing empirical foundation for future research. Additional research needs to be conducted to further test the validity of the mental model constructs. Future researchers may wish to test these mental model relationships *in-situ*. By investigating specific new product development processes, identification of the mental model constructs held for those processes could be explored. In addition, the stages at which new product development process mental model changes occur could be investigated. This research could also link environmental conditions to the mental models held by individuals.

Identification of individual difference variables could be of value to researchers in clarifying the relationships. While educational background has a significant relationship to Mktg-Info and Role, it is also possible that some individual difference variables influence the choice of educational major as well.

It has been noted that groups can have the same informational biases as individuals (Rouse 1992; Schwenk 1988; Walsh, Henerson, and Deighton 1988). Future researchers may wish to investigate the political process and a group's advocacy of their position to maintain commitment to that group's shared mental model. This could lead to research in how new product development teams use political behavior, argumentation, and personal power (Schwenk 1988).

Researches may wish to use the results of this study in actual communication training sessions with new product development team members to determine if the knowledge of one's initial mental model actually modifies one's reactions to others.

Weinrauch and Anderson (1982) have recommended that formal and informal management development should include engineering having classes for marketers and marketers having classes for engineers. Following the Japanese leads, these groups could hold meeting to solve conflicts and they could switch roles to experience each area of responsibility. On the job, individuals could utilize job rotation.

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APPENDIX A
ALTERNATIVE NEW PRODUCT DEVELOP FRAMEWORKS

ALTERNATIVE NEW PRODUCT DEVELOP FRAMEWORKS

MARKETING BASED (Demand Based)	MARKETING/R&D (Interfaced)
<p>STRATEGIC PLANNING STAGE "Top management should define the products and markets to emphasize (Kotler 1991, p. 317)."</p>	<p>OPPORTUNITY IDENTIFICATION Find markets which are growing, profitable, and vulnerable and generate ideas to tap this potential (Urban and Hauser 1993, p. 40). <i>Strategic Planning Stage:</i> Includes opportunity identification and screening (Crawford 1991a).</p>
<p>IDEA GENERATION "The Marketing concept holds that <i>customer's needs and wants</i> are the logical place to start in the search for new-product ideas (Kotler 1991, p. 317)."</p>	<p>DESIGN Design a product based upon consumer's needs and wants - and position the product against competition (Urban and Hauser 1993, pg 41.). <i>Ideation Stage:</i> Identify problems and possible new concepts to meet consumer's needs (Crawford 1991a).</p>
<p>IDEA SCREENING Start with a large number of ideas and reduce to a practicable few (Kotler 1991, pg 320).</p>	
<p>CONCEPT DEVELOPMENT AND TESTING Refine product ideas into testable product concepts then test these against appropriate target consumers (Kotler 1991, p. 323).</p>	<p>TESTING Test product and strategy against the targeted groups (Urban and Hauser 1993). <i>Screening Stage/Development Stage:</i> Preliminary concept tests and development through alpha and beta testing and business plan analysis (Crawford 1991a).</p>
<p>MARKETING STRATEGY DEVELOPMENT The new-product manager must develop a mix which will allow for successful introduction (Kotler 1991).</p>	
<p>BUSINESS ANALYSIS Estimate sales, cost, profit projections to determine if they meet companies objective (Kotler 1991).</p>	
<p>PRODUCT DEVELOPMENT "If the product concept passes the business test, it moves to R&D and/or engineering to be developed into a physical product (Kotler 1991, p. 332)."</p>	<p>INTRODUCTION Develop introduction strategy based upon competitive and market considerations (Urban and Hauser 1993). <i>Commercialization:</i> Test product and revise strategy heading toward launch (Crawford 1991a).</p>
<p>MARKET TESTING After total product development, market testing allows for learning how customers and dealers react to the product (Kotler 1991).</p>	
<p>COMMERCIALIZATION The firm will have to decide on timing, location, target markets, and initial strategy (Kotler 1991).</p>	<p>LIFE-CYCLE MANAGEMENT As the product moves through its life cycle - develop monitoring system to allow the firm to keep up with the changing nature of the competitive environment (Urban and Hauser 1993).</p>

APPENDIX B
VARIABLE SOURCES

NEW PRODUCT CHOICE VARIABLE

Alternative New Product Choice

SCALE ITEMS	DESCRIPTION	CITATIONS
Discontinuous Innovation	New breakthrough products.	Zikmund (1993)
New Unrelated Technology	No link to existing technology.	Meyer and Roberts (1986)
Completely Unique Product	Basis for marketing innovation.	Nyström (1985)
Unique technological solution.	Basis for technical innovation based on new knowledge.	Nyström (1985)
Dynamically Discontinuous Innovation	Major improvements on existing products where the consumer is not required to learn new behavior patterns.	Zikmund (1993)
New Related Technology	Compatible with existing technology.	Meyer and Roberts (1986)
Major Enhancement	New base technology to product line.	Meyer and Roberts (1986)
Conventional technology solution.	Basis for technical innovation based on existing technology.	Nyström (1985)
Continuous Innovation	A product variation or small change on existing products.	Zikmund (1993)
Minor Improvement	Use the same core technology.	Meyer and Roberts (1986)
Product Essentially Similar to competing Products.	Basis for marketing innovation.	Nyström (1985)

MENTAL MODEL VARIABLES

Time Orientation

ITEM	CITE	JUSTIFICATION
<p>It takes a long time to receive feedback from the environment for decisions that you make.</p>	<p>Lawrence and Lorsch's (1967, 1969)</p>	<p>The marketing core was engaged in activities which enabled them to receive feedback at a much shorter time rate than those in the technical core who would have to wait for feedback from technical undertakings.</p>
<p>It is more important to consider the short term effects rather than long term effects of decisions.</p> <p>It is important to responding quickly to the market.</p> <p>It is important to get new products to market, even if they have not been technically refined.</p>	<p>Gupta, Raj, Wilemon (1985a, 1986) Kamath, Mansour-Cole, and Apana (1993) Pavia (1991) Urban and Hauser (1993)</p>	<p>The general agreement is that marketing managers tend to have short-run perspectives while engineers and scientists tend to focus on long-term results.</p> <p>The technical core sees marketers as too quick to respond to the market.</p> <p>Marketers are seen as rushing new products to the market before they can be technically refined.</p>
<p>It is important to respond very quickly to changes in the environment.</p> <p>Technology personnel respond too slowly to competitive threats.</p>	<p>Reukert and Walker (1987)</p>	<p>Marketers complain that the technical core is not able to respond quickly enough to changes in the marketplace due to slow response times and the technical core's lacked an understanding of response times necessary to be competitive.</p>
<p>It is important to have patent protection, even if this takes a long time to obtain.</p>	<p>McNulty and Whittington (1992) Nyström (1985)</p>	<p>Technologist have received training in a hard science, and perceive their work as the production of technology. The production of technology can lead to patent protection, but this requires long-term development .</p>

Market Information

ITEM	CITE	JUSTIFICATION
<p>Formalized marketing research (concept testing, product prototypes, and market tests) is the best way to obtain information from the markets on their new product needs.</p> <p>The use of qualitative marketing research (focus groups) is the best way to obtain information on the markets needs.</p>	Shanklin and Ryans (1987)	Market driven firms rely upon more formalized research methods while for technically driven firms, little stock may be placed in mathematically based marketing research, due to the small amount of historical data (new technology doesn't fit with consumer's experience).
New technology does not fit with most consumer's experience.	Von Hippel (1986)	The use of "lead-users" gives more product-class experienced subjects than the use of general consumers.
Marketing research is able to supply information on customer needs which are not met by current products.	Reukert and Walker (1987)	The technical core believes that marketers are not able to supply information on customer needs which are not met by current products.
<p>Information provided by marketers does not focus on customer's real needs.</p> <p>Marketers are not technically sophisticated.</p> <p>Marketing information is biased to marketing's short term interests.</p> <p>Marketing information is reactive rather than foreseeing real customer needs or competitive threats.</p>	Gupta and Wilemon (1991)	Gupta and Wilemon found that the reason that the technical core would not accept marketing's information was due to the perception that the information did not focus on customer's real needs, marketers were not technically sophisticated, the information was biased to marketing's short term interests, and the focus was reactive rather than foreseeing real customer needs or competitive threats.
The use of formalized marketing information is more important for established products than new products.	Roberts (1990)	The type of information upon which the firm relies may change as the firm evolves. Roberts found that entrepreneurial firms initially rely upon the founders feel for the market's needs rather than research. The use of formalized information is expected to increase as the firm ages.

Outcome Expectations

ITEM	CITE	JUSTIFICATION
It is more important to focus on the marketing environment than the technical environment.	Lawrence and Lorsch's (1967, 1969)	They found that the marketing core was more focused on the market environment while the technical core was focused on the technical environment.
The health of the firm is derived from immediate sales and profits. It is important that projects lead to market success.	Gupta, Raj, and Wilemon (1986) Maidique (1984)	The marketing core's business training may lead them to look at the health of the firm as being deriving from immediate sales and profits. The marketing core may be interested in projects which lead to market successes (even with marginal returns).
It is important to protect the profitability of existing products by countering competitive new products.	Urban and Hauser (1993)	Marketers may want protect the profitability of existing products by countering competitive new products.
It is important to maximize sales. It is important to maximize market share.	Ruekert and Walker (1987)	Marketers may want to maximizing sales or market share.
Return on investment is the main criteria for evaluating a new product alternative.	Hayes and Abernathy (1980)	A results now - ROI orientation could be used by the marketer to differentiate between a go and no-go for a new product alternative (Pavia 1991).
The long term health of the firm is derived from new technology and innovation. Technology can lead to new approaches - new strategy - and superior competitive positions.	Frankwick et al. (1994)	The technical core may see the long term health of the firm as being derived from new technology and innovation, technology can lead to new approaches - new strategy - and superior positions
It is important to achieve technical performance in new products even if this does not lead to immediate success for new products.	Maidique (1984)	The technical core may even strive for technical performance for performances sake - even if this will not lead to successful new products

New technologies represent opportunities to meet consumer's needs which have been previously latent.	Urban and Hauser (1993)	New technologies may present opportunities to meet consumer's needs which were previously latent (note: this does not imply that ideas are generated in a vacuum - they are often based upon the technologist's view of how to benefit the consumer).
Patent protection from the production of technology can lead to long term competitive advantages.	Nyström (1985)	Patent protection from the production of technology can lead to long term competitive advantages.

Role Expectations

ITEM	CITE	JUSTIFICATION
<p>The marketing core should find customer needs so firm can react to customer's requests.</p> <p>Technical personnel should identify customer's needs and help develop products which satisfy those needs.</p>	Urban and Hauser (1993)	Urban and Hauser state in their new product development text that the marketing core should find customer needs so firm can purposively react to customer's requests. The technical cores, on the other hand, should identify customer's needs and help develop products which satisfy those needs.
The existence of a product can create demand for that product.	Shanklin and Ryans (1987)	A product can create a market - or the product itself is responsible for the creation of demand.
Effective marketing (product push) can give a new product a competitive advantage.	Bruce and Rodgus (1991)	Effective marketing (product push) may be perceived as giving the new product a competitive advantage.
<p>Marketing's role is to sell.</p> <p>Technology should drive marketing.</p>	McNulty and Whittington (1992)	Marketing's role is seen as selling due to the technologist's believe that technology should drive marketing.
Marketing should be able to find commercial applications for new technology.	Gupta, Raj, Wilemon (1985)	Gupta, Raj, Wilemon found that one of the major complaints that the technical core had against marketers was that they were dissatisfied with marketing's ability to find commercial applications for the technology.

VALIDITY MEASURES

ITEM	CITE	JUSTIFICATION
Marketing plays a major role in reducing the risk of introducing a new product.	Moenaert and Souder (1990) Anderson 1982; Wind and Robinson 1983	Part of marketing's role in the new product development process is to reduce the risk involved in introducing the new product.
Marketing's interaction with the served market is the best way to find out the needs of that market.	Conway and McGuinness (1986) Kamath, Mansour-Cole, and Apana (1993)	The marketing core may undertake risk reduction by identifying problems or opportunities which arise from the company's specific strategy of serving a defined market and through the marketing core's interaction with the needs of that market.
Demand for products should precede and trigger product development. Demand for products should develop and set the funding for marketing strategies.	Nyström (1985) Shanklin and Ryans (1987)	The marketing core may believe that demand should precede and trigger product development and be the formulation of and set the funding for marketing strategies.
Technical personnel lack a strong customer orientation. Technical personnel produce what they think the customer needs rather than listen to the customer.	Gupta, Raj, Wilemon (1985) Reukert and Walker (1987)	The marketing core may believe that the technical core lacks a customer orientation, and may produce what the technical core "thinks" the customer needs rather than listen to the customer.
The way to meet consumer needs is through R&D and product development.	Bruce and Rodgus (1991) Urban and Hauser (1993).	The technical core may see their role as directed toward solving consumer problems through preemptive R&D and product development.
Viable new product concepts can be the result of a technological discovery or from the availability of a new technology.	Conway and McGuinness (1986)	A new product concept can be the result of a technological discovery or from the availability of a new technology.
Following customer demand may lead to short term innovation.	McNulty and Whittington (1992)	Following customer demand may lead to short term innovation.

<p>One of the best measures to evaluate new products is the level of technological innovation.</p> <p>The main goal of new product development is to develop a novel or unique technological solution that can lead to patent protection.</p>	<p>Kamath, Mansour-Cole, and Apana (1993) Nyström (1985)</p>	<p>One of the main measures a technical core member may use in evaluating new products may be a level of technological innovation. The goal may be to develop a novel or unique technological solution to the problem which can lead to patent protection.</p>
<p>Close contact with the general customer may hinder the technical person's ability to perform their practice.</p>	<p>McNulty and Whittington (1992)</p>	<p>The professional practice of the technical core may be perceived at risk of corruption when they expose themselves to the public.</p>

APPENDIX C
SURVEY INSTRUMENT



Missouri Southern State College

June 27, 1995

Dear Product Development and Management Association Member:

I am currently conducting research for my Ph.D. dissertation on the new product development process. I would like to ask your help by having you take a few minutes of your time to complete the enclosed questionnaire.

Your decision to participate in this survey is completely voluntary. This is an anonymous survey, and no one will have access to the raw data (except for myself).

A summary of the results will be made available to your local PDMA chapter president. If you would like to know the results of the study, please write me indicating your address, and I will mail a summary of the findings to you after the study is complete.

Please respond to each of the questions and return the completed questionnaire through the U.S. mail in the enclosed self-addressed, stamped envelope as soon as possible. If you have any questions concerning any of the items in the survey, please feel free to call me at (417) 625-3120.

I sincerely thank you for your time and help. I hope that you will take a few minutes of your time now and respond to the enclosed survey.

Sincerely,

Brad Kleindl
Assistant Professor

INSTRUCTIONS

This questionnaire is designed to examine your beliefs about the new product development process. In completing each section of the questionnaire, please answer in a way which represents your level of agreement or disagreement with each statement by circling the number which best represents your belief.

A. <u>Your beliefs about the new product development process:</u>	<u>Strongly</u> <u>Disagree</u>						<u>Strongly</u> <u>Agree</u>
1. In making decisions, it is more important to consider short term effects rather than long term effects.....	1	2	3	4	5	6	7
2. It is important to respond quickly to the changing needs of the customer.....	1	2	3	4	5	6	7
3. It is important to get new products out, even if they have not been technically refined.....	1	2	3	4	5	6	7
4. It is important to respond quickly to changes made by competitors.....	1	2	3	4	5	6	7
5. Technical people are generally too slow to respond to competitive threats.....	1	2	3	4	5	6	7
6. It is important to have patent protection, even if this takes a long time to obtain.....	1	2	3	4	5	6	7
7. Formal marketing research (concept testing, product prototypes, market tests) is the best way to obtain information from customers on new product needs.....	1	2	3	4	5	6	7
8. The use of formal marketing research is more important for established products than new products..	1	2	3	4	5	6	7
9. The use of less formalized marketing research (e.g. focus groups, interviews) is the best way to obtain information on customer's needs.....	1	2	3	4	5	6	7
10. Marketing research is the best source of information on new products that meet customer's needs.....	1	2	3	4	5	6	7
11. Information provided by marketing people does not focus on customer's real needs.....	1	2	3	4	5	6	7
12. Most marketing people are not technically sophisticated	1	2	3	4	5	6	7
13. Marketing information is biased toward marketing's short term interests.....	1	2	3	4	5	6	7
14. Marketing people are more interested in immediate customer behavior rather than long term customer needs.....	1	2	3	4	5	6	7

	<u>Strongly Disagree</u>					<u>Strongly Agree</u>	
15. It is more important to focus on forces that affect marketing rather than on technical forces.....	1	2	3	4	5	6	7
16. The long term health of the firm is reflected by immediate sales and profits.....	1	2	3	4	5	6	7
17. It is important to protect the profitability of existing products by countering competition with competitive new products.....	1	2	3	4	5	6	7
18. The most important goal for a firm is to maximize sales.....	1	2	3	4	5	6	7
19. Return on investment should be the main criteria for evaluating a new product alternative.....	1	2	3	4	5	6	7
20. The long term health of the firm is derived from new technology and innovation.....	1	2	3	4	5	6	7
21. The most important goal for a firm is to maximize market share.....	1	2	3	4	5	6	7
22. Use of technology is the best way to find new approaches to strategy and to achieve superior competitive positions.....	1	2	3	4	5	6	7
23. It is important to achieve technical performance in new products even if this does not lead to immediate sales success for new products.....	1	2	3	4	5	6	7
24. New technologies represent opportunities to meet needs that customers have not previously recognized.	1	2	3	4	5	6	7
25. Patent protection from the production of technology is the best way to long-term competitive advantages..	1	2	3	4	5	6	7
26. Only marketers should identify customer's needs so that the firm can react to customer requests (through R&D).....	1	2	3	4	5	6	7
27. Technical personnel should identify customer's needs to help develop products which satisfy those needs....	1	2	3	4	5	6	7
28. If a product can be made, it can be sold.....	1	2	3	4	5	6	7
29. Effective marketing (pushing a product) can give new products a competitive advantage.....	1	2	3	4	5	6	7
30. Marketing's role is to sell new products.....	1	2	3	4	5	6	7
31. Technological ideas should drive the marketing of new products.....	1	2	3	4	5	6	7

	<u>Strongly</u> <u>Disagree</u>						<u>Strongly</u> <u>Agree</u>
32. Marketing should be able to find customer markets for new technology.....	1	2	3	4	5	6	7
33. Marketing plays a major role in reducing the risk of introducing a new product.....	1	2	3	4	5	6	7
34. Working with the customer is the best way to find new product ideas.....	1	2	3	4	5	6	7
35. The best source of new product ideas comes from R&D and product development.....	1	2	3	4	5	6	7
36. Customer demand for products should precede and trigger product development.....	1	2	3	4	5	6	7
37. Close contact with the customer may hinder the technical person's ability to do their job.....	1	2	3	4	5	6	7

B. YOUR PROJECT

An organization can be involved with a variety of new product projects over time. For the next two questions, please indicate the new product project on which you would personally prefer to participate if you were given a choice. *This preference should be regardless of your current business responsibilities.* Choose anywhere along the scale from 1-7.

1.

A product which has small changes or is a minor <u>variation of a current product.</u>	A major enhancement to a product, based on the use of <u>conventional technology.</u>	A major enhancement to a product, based on the use of <u>new technology.</u>	A new <u>breakthrough</u> product with <u>no link</u> to existing technology - or could be a new unique use of technology.
Please Circle: 1 2 3 4 5 6 7			

2.

A minor product improvement which <u>customers would perceive</u> as similar to current products.	A major product enhancement where <u>customers must make modest changes in current skills</u> to use the new product.	A major product enhancement where <u>the customer will have to learn new skills</u> to use the product.	A breakthrough product where the <u>customer needs to learn new behavior patterns</u> as well as new skills to use the product.
Please Circle: 1 2 3 4 5 6 7			

- | | | |
|---|---------------------------|--|
| 4. Our firm rarely changes its practices to keep up with competitors. | 1 2 3 4 5 6 7 | Our firm often changes its its practices to keep up with competition. |
| 5. The rate at which product/ services become obsolete in this industry is very slow. | 1 2 3 4 5 6 7 | The rate at which product/ services become obsolete in this industry is very fast. |
| 6. Actions of competitors are very easy to predict. | 1 2 3 4 5 6 7 | Actions of competitors are very hard to predict. |
| 7. The external environment poses a great deal of threat to the survival of our firm. | 1 2 3 4 5 6 7 | There is very little threat to the survival of our firm. |

E. ABOUT YOUR BUSINESS:

For the following questions, please consider your business unit within the parent organization.

1. Briefly describe the products for the business unit : _____
2. Please indicate your estimate of the number of employees in your business unit: _____
3. What is your estimate of the annual sales of your business unit:

a) Less than \$250,000	c) \$1 Million - \$10 Million	e) \$100 Million or More
b) \$250,000 - \$1 Million	d) \$10 Million - \$100 Million	

4. What levels of management are usually responsible for making the following business decisions for the business unit:

	Team Decision	Middle Managers	Functional Executives - In Business Unit.	Divisional Top Executives or Functional Ones If No Divisions.	Topmost Levels of Management
a) Capital Budgeting	1	2	3	4	5
b) New Product Introduction	1	2	3	4	5
c) Pricing of Products	1	2	3	4	5
d) Entry Into New Markets	1	2	3	4	5
e) Hiring and Firing	1	2	3	4	5

PLEASE FOLD
& PLACE IN
THE POSTAGE
PAID RETURN
ENVELOPE.

Thank you again
for your participation.

VITA

Brad Alan Kleindl

Candidate for the Degree of

Doctor of Philosophy

Thesis: THE IMPACT OF MENTAL MODELS ON MARKETING CORE AND TECHNICAL CORE NEW PRODUCT CHOICE

Major Field: Business Administration

Biographical:

Personal Data: Born in Fort Atkinson, Wisconsin, on July 1, 1955, the son of James and Elaine Kleindl. Married December 26, 1987, to Jane Ellen Roberts Kleindl.

Education: Graduated from Freeport High School in Freeport, Illinois in June of 1973; received Associate of Arts, May 1979, Highland Community College, Freeport, Illinois; Bachelor of Science in Business Administration, May 1981; Southern Illinois University, Masters of Business Administration, August 1982, Southern Illinois University, Carbondale, Ill.; completed requirements for the Doctor of Philosophy degree at Oklahoma State University, Stillwater, Oklahoma, in May 1996.

Professional Experience: Assistant Professor, 1993-1995, Director, Center For Entrepreneurship And Small Business Management, 1986-1991, Missouri Southern State College, Joplin, Missouri; Instructor, Chairperson, Business Department, Marshalltown Community College, 1983-1986; Instructor, Highland Community College, Freeport, Illinois, 1992-1993; U.S. Army, 201st Signal Company, Electronics Maintenance Chief, Frankfurt, West Germany.

Honors and Professional Organizations: Beta Gamma Sigma, American Marketing Association; Academy of Marketing Science.

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 05-26-95

IRB#: BU-95-029

Proposal Title: THE IMPACT OF MENTAL MODELS ON MARKETING CORE
AND TECHNICAL CORE NEW PRODUCT CHOICE

Principal Investigator(s): Stephen J. Miller, Brad Kleindl

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

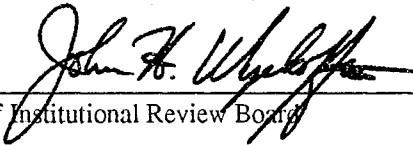
APPROVAL STATUS SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT
NEXT MEETING.

APPROVAL STATUS PERIOD VALID FOR ONE CALENDAR YEAR AFTER WHICH A
CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD
APPROVAL.

ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR
APPROVAL.

Comments, Modifications/Conditions for Approval or Reasons for Deferral or Disapproval
are as follows:

Signature:


Chair of Institutional Review Board

Date: May 31, 1995