NOTE TO USERS

Market Vision for Radically-New, High-Tech Products

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ABSTRACT

Market Vision for Radically-New, High-Tech Products

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Market Vision (MV) and Market Visioning Competence (MVC) are critical concerns when developing successful, radically-innovative products. The inherent risks and rewards associated with such high-stake ventures require that firms create a long-term vision to guide their effort. A clear and compelling vision about the product-market opportunities associated with radically new ventures can help firms achieve a significant competitive advantage, which ultimately can lead to superior financial results.

Despite today's increased rate of discontinuous innovation and hence the importance of having effective MV and MVC, there are major gaps in this area of knowledge and research. Thus, the first objective of this dissertation is to develop an in-depth understanding of the concepts that entail MV and MVC for radically new high-tech products. In line with this, the research determines: the specific variables (and associated measures) that comprise these two concepts, to what extent they are distinct, and how they are related. The second objective is to test whether MVC and MV are linked to Early Performance in the development of radically-new, high-tech products.

Exploratory and objective empirical research, in addition to a literature review, helped define MV as "a clear and specific mental model/image that organizational members have of a desired and important product-market for a new advanced technology", and MVC as "a set of individual and organizational capabilities that enable the linking of advanced technologies to a future market opportunity". Based on samples of firms involved in early technology development, the measurement study suggests that

four factors underly MVC (Networking, Idea Driving, Proactive Market Orientation Market Learning Tools) and five factors comprise MV (Clarity, Magnetism, Specificity, Form, Scope). Structural equation modeling demonstrates that MVC significantly and positively impacts MV, and that each of these constructs significantly and positively influences separate elements of Early Performance. In addition, moderators were studied to explore their impact on the main structural relationships. This is the first empirical study to develop scales to measure each of these main constructs and to combine them in a comprehensive model with Early Performance metrics.

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Glossary of Commonly Used Abbreviations

Theoretical Abbreviations	*Terms*
MV	Market Vision
MVC	Market Visioning Competence
EP	Early Performance
AAC	Ability to Attract Capital
ESC	Early Success with Customers
TCA	Technical Competitive Advantage
MORTN	Reactive Market Orientation
MOPRO	Proactive Market Orientation
RBV	Resource-Based View
FFE	Fuzzy Front-End
NPD	New Product Development
TIM	Technology and Innovation Management
SBU	Strategic Business Unit
PIC	Product Innovation Charter
DSS	Decision Support System
TOA	Technology Opportunity Analysis

Statistics Abbreviations	*Terms*
EFA	Exploratory Factor Analysis
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
RMSEA	Root Mean Square Error Approximation
KMO	Kaiser-Meyer-Olkin Measure of Sampling Adequacy
AVE	Average Variance Extracted

Organization Abbreviations	*Terms*
USPTO	United States Patent and Trademark Office
PDMA	Product Development and Management Association
MANCEF	Microelectronics and Nanotechnologies Commercialization Education Fund
CME	Canadian Microelectronics Association
CATA	Canadian Advanced Technology Alliance

Chapter 1: Introduction

1.1 Overview of Market Vision and Market Visioning Competence

Why is it that some firms seem to be in the right place at the right time when the next big thing comes down the pipe? Is it just luck; or, is there something that firms can learn or do to improve their chances of success with choosing the next "killer app"? In other words, can firms be proactive about creating and/or selecting an effective and strong *Market Vision* for a new advanced technology? This dissertation seeks to provide an answer to these questions, for firms undertaking to develop radically new products, by examining the realm of Market Vision: what it is, how it evolves and its potential impact on early firm performance. Based on a broad review of the literature from disciplines including economics, organizational theory, management of technology, and marketing with new product development, Market Vision can be seen as a clear and specific mental model or image that organizational members have of a desired and important product-market for a new technology. This image includes potential users, a potential product concept and the potential interaction of user and product in the use environment and in the marketplace.

In developing a conceptual model to serve as a focal point for this dissertation, an important *a priori* assumption is made that Market Vision results from *Market Visioning Competence*: the ability of individuals in organizations to link advanced technologies to market opportunities of the future. This assumption is based on the perspective forwarded in the "resource-based view" (RBV) of the firm, as proposed in the dynamic capabilities literature, which suggests that learning results in firm-specific competitive advantages which improve performance. The theory developed in this dissertation will demonstrate that Market Vision and Market Visioning Competence represent competitive advantages that are largely accomplished through learning.

1.2 The Resource-Based View:
The Importance of Learning and the Dynamic Capabilities Approach

Learning in organizations is at the heart of much of the organizational research stream. In its various forms, "organizational learning" (e.g., Argote, Beckman & Epple, 1990; Cyert & March, 1963; Levitt & March, 1988; Nembhard, 2000), "knowledge management" (Hansen, 2002; Hansen, Nohria & Tierney, 1999; Leonard-Barton, 1995; Nonaka & Takeuchi, 1995), and "sensemaking" (e.g., Gioia & Mehra, 1996; Gioia, Thomas, Clark & Chittipeddi, 1994), the underlying argument remains fundamentally the same: learning in organizations is critical to performance because it provides firms with a way to build defensible competitive advantages. Each of these strands of the learning literature has in common that they are centred in a resource-based view, which emphasizes firm-specific resources and capabilities, and the existence of isolating mechanisms as the critical determinants of firm-based performance (Penrose, 1959; Rumelt, 1984; Teece, 1984; Wernerfelt, 1984). Based primarily on Penrose (1959), isolating mechanisms exist because capabilities (which some refer to as "resources") are "sticky" and, difficult to imitate (Barney, 1986). As such, capabilities stick to a specific firm and are thus isolated. These resources can be physical (e.g., unique equipment, innovation protected by patents) or intangible (e.g., brand equity, operating routines) (Silverman, 1999).

Within the learning framework, organizational search is conceived as a process by which organizations are able to adapt within their external environments (Baum, Li & Usher, 2000). Such search efforts have been conceptualized as a problem of allocating organizational resources between exploration and exploitation (Crossan, Lane & White, 1999; Levinthal & March, 1993; March, 1991). Exploitation refers to learning gained via local search and experiential refinement, while exploration refers instead to learning through processes of variation, planned experimentation and play (Baum, Li & Usher, 2000). The main focus of this research is on the latter type of process: exploration.

One extension of the resource-based view, which helps to better understand exploration, focuses on dynamic capabilities (Teece, Pisano & Shuen, 1997). Traditionally, the RBV has focussed on the "exploitation" side of the equation: that is, on understanding how existing internal and external firm-specific capabilities can be best utilized. Only recently have researchers begun to focus on "exploration": how organizations develop firm-specific exploration capabilities in the first place and how they then share and integrate new information to respond to shifts in the environment (e.g., Clark & Fujimoto, 1991; Henderson, 1994; Iansiti & Clark, 1994).

In effect, learning—knowledge creation and building through sharing—is a resource-based dynamic capability which allows firms in dynamic environments, such as those provided by radical innovation, to build further capabilities and resources, which provide defensible competitive advantages that can be turned into profits, or "economic rents" (Wernerfelt, 1984). The capabilities of interest in this dissertation are those that enable firms involved with radical innovation, through various exploratory learning processes (as reflected in Market Visioning Competence), to build an understanding of a viable and potentially successful product-market option to pursue in the future (as reflected in Market Vision).

Theory construction and testing, covered in the following chapters, will demonstrate that Market Visioning Competence requires a subtle balance between the dynamic learning capabilities (i.e., skills, assets, values) of *individuals* (e.g., networking, idea driving) and of the *organizations* in which they participate (e.g., proactive market orientation, market learning tools). The competence, reflected by these capabilities, allows organizational members with ideas stemming from early technology development to develop an effective mental image, or Market Vision, toward radically-new, high-tech products for future markets. Previous research in the areas of organizational and project vision provide some clues about what factors may comprise Market Vision. Most of these are of an *extrinsic* nature in that they describe elements

that are external to the vision. When considering the essence of the vision, itself, it is the *intrinsic* components which are of interest. These denote what the vision or image looks like and what it represents to members of an organization. It is this theoretical realm which has been previously untapped.

Market Vision, and the Market Visioning Competence that leads to it, are considered important because they both are likely to impact a firm's chances of success early on in the game with radically new products. As such, performance becomes a third critical element in the model developed in this thesis. Figure 1 illustrates the proposed basic relationships.

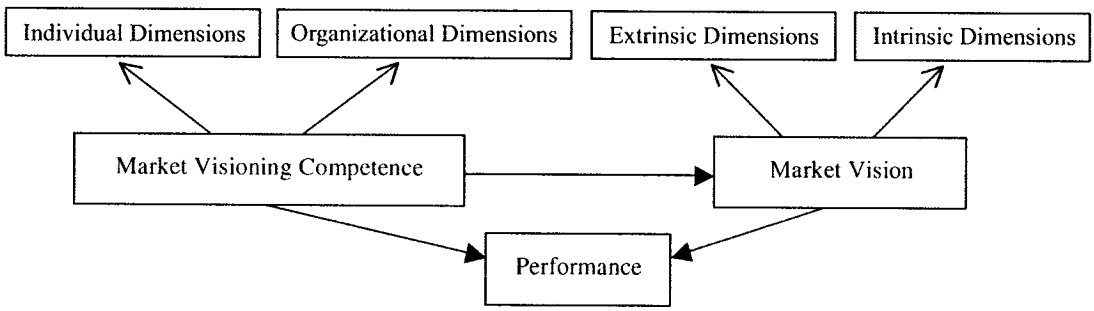

Figure 1. Key Relationships Investigated in the Literature Review

To date, Market Vision and Market Visioning Competence have received only limited attention from researchers. Some of the theoretical concepts underlying these constructs, however, have been cited by both academics and managers as critical to firm performance. As such, this dissertation aims to develop a better theoretical understanding of both Market Vision and Market Visioning Competence through theory construction and development. By examining the nature and underlying dimensions of these two constructs, and how each impacts firm performance early on in what is known as the "fuzzy front-end" of new product development, a further aim is to help firms gain the best possible chance of market success with radically-new, high-tech, products.

1.3 The Fuzzy Front-End

The "fuzzy front-end" (FFE), a term first popularized by Smith and Reinertsen (1991), is considered to be the earliest stage of the new product development (NPD) process and is meant to denote all time and activity spent on an idea prior to the first official group meeting to discuss it or, what they call, "the start date of team alignment". Another way of thinking about this concept is to highlight the FFE as that territory leading up to organizational-level absorption of the innovation process (Cohen & Levinthal, 1990).

While a concentrated effort toward building a better understanding of the FFE has been undertaken in earnest only during the last decade, scholars of NPD have discussed "up front activities" in a generic way for more than twenty years (e.g., Crawford, 1980). For example, we can clearly see that there are *early* and *late activities* comprising the FFE, regardless of type of innovation (incremental or radical). In the case of early FFE activities, authors speak of problem/opportunity structuring and/or identification/recognition (Leifer *et al.,* 2000; Urban & Hauser, 1993), information collection/exploration (March, 1991), and "up-front homework" (Cooper, 1996). These activities, however, have tended to be described in somewhat non-specific terms. Late FFE activities are seen as involving aspects of idea generation and concept development (Cooper, 1990; Urban & Hauser, 1993), continued information collection, and informal- or pre-screening (Crawford, 1980; Crawford & di Benedetto, 2003), with possibly some initial fund allocation for exploring a new idea (Cooper, 1990; Cooper & Kleinschmidt, 1986).

The activities and decisions comprising the FFE are the starting point for all NPD processes and, therefore, determine the direction of any new product path. Therefore, it is clear that a better understanding of these steps (including Market Visioning Competence and resultant Market Vision) could ultimately lead to competitive advantage. Additionally, according to Smith and Reinertsen (1991), of all the actions firms can take to improve their NPD process, those taken at the FFE give the greatest time-savings for the least expense. This is related to the relatively low cost of generating several potential ideas compared to

the cost of actually implementing any one idea (Urban & Hauser, 1993). Several studies have provided evidence of a link between new product performance and time spent on up-front activities (Cooper & Kleinschmidt, 1995; Kuczmarski & Associates, 1994; Urban & Hauser, 1993); thus, a search for better processes in support of the fuzzy front-end appears to be called for in order to help firms achieve greater success in their efforts to develop new products. Given that Market Visioning is an important FFE competence (Colarelli O'Connor & Veryzer, 2001), and one which is not well understood particularly in terms of the outcome vision itself, this is one key area which if better developed may be able to enhance early success of new products involving discontinuous innovations.

1.4 The Radical Innovation Context

The radical innovation scenario is proposed to be the condition under which Market Visioning Competence and Market Vision have their greatest impact on firm-level performance, particularly during the early stages of the FFE of NPD. In order to better understand why this is likely to be the case, it is necessary to understand: first, how technology life cycles are initiated and progress through time; second, the nature of radical innovation; third, how radical innovation diffuses; and fourth, the relationship between Market Vision and radical innovation.

1.4.1 Relationship of Radical Innovation to Technology Life Cycles

As mentioned, early performance for firms is likely to be most impacted by Market Vision under conditions of radical innovation. This is related to the fact that early on in a given technology life cycle, when radical innovation is most prevalent (Sahal, 1981), different firms' visions of possible market applications for a given technology are typically fairly divergent. Divergent thought is exhibited in the process of problem-solving when many, wide-ranging and unusual ideas are generated. Thought patterns occur in different directions,

through searching and variety seeking. This is in contrast to convergent thinking, where information tends to lead to one right, best, or conventional answer (Baer, 1993; Guilford, 1967). In sum, radical innovation leads to high-tech performance because it entails more than normal divergent thinking, and this can be expected to result in the generation of many alternative application markets (Colarelli O'Connor, 1998). Thus, during the early stage of a given technology cycle, technology performance can be expected to be quite high as the overall number of potential market applications being ideated and pursued is likely to be large and diverse. Technological performance, in the broadest sense, is the impact which a generic technology has on society in terms of delivered benefits. As such, the ultimate measure of a generic technology's performance is the level of increased customer satisfaction or range of functional performance a technology delivers over its lifetime (Goodman & Lawless, 1994).

Sahal (1981) was one of the first researchers to show empirically that, over time, there is a gradual improvement in understanding and a progressive exploitation of a technology, as its potential becomes better recognized. Sahal researched technological innovation across several industries and found that its pattern was replicated in several technology types, with only subtle differences. According to Sahal, technology life cycles are usually identifiable as taking the form of "S-curves", where the bottom of the "S" represents "new invention" or the "basic research period" of a given technology, the middle of the "S" implies technology improvement over the development period, and the top of the "S" curve represents a mature technology. Christensen's (1992) technology "S-curve" theoretically captures the potential for improvement in a technology's performance, which results from a certain amount of engineering effort. The curve is not a measure of sales growth; instead, it is a measure of the rate of technological progress.

Whereas at the beginning of the technology life cycle (or bottom of the S-curve) the potential for technology performance improvement is quite great, at the end of the life cycle, further increased engineering effort leads to diminishing returns in the performance of the technology. That is, the technology is approaching some natural or physical limit as

it matures, in terms of the number of potential applications it may be utilized in or the ability to deliver additional benefits.

Relating the concept of the technology life cycle to new product development performance by the firm, it is possible to deduce the following. The potential impact that any one firm can have on the marketplace is much higher early on in the technology life cycle, at the bottom of the S-curve, when radical innovation is most prevalent and when the highest number of market applications and additional benefits still remain untapped. This is related to the high level of divergence in terms of both ideas and potential opportunities or applications being considered in a variety of potential market visions. Due to this, there is a higher likelihood that some of the potential ideas and opportunities will be unusual and therefore in the range considered radical (i.e., 5-to-10 times improvement in benefits or 30% reduction in costs compared to what the previous generation of the technology delivered), which can have the biggest impact on society in terms of delivered benefits. From a firm's perspective, involvement with a technology during this stage usually entails involvement at the FFE of the NPD process, as was discussed previously, because this is the stage where search efforts are broadest exhibiting high levels of divergence, exploration and opportunity identification. Over time, convergence of Market Vision occurs as different firms begin to gain a similar understanding of evolving markets and market applications, often resulting in "dominant designs" (Abernathy & Utterback, 1978). In other words, in the middle of the S-curve, potential market visions become realized. This, in turn, leads to more individuals and organizations becoming aware of a more narrowly defined view of a technology and, as competition for those specific markets and applications increases, the nature of innovation becomes more incremental than discontinuous. Therefore, by the time a technology reaches the top of an S-curve, potential market applications are mature and the vast majority of innovations are incremental. Therefore, Market Vision is projected to have a much greater impact on performance early on in a given technology life cycle, when radical innovation is more prevalent. Given the importance of Market Vision during this period of time when radical

innovations are likely to be most dominant, at the bottom of the S-curve, this dissertation focuses on this particular context. In order to set the scene for this, a literature review follows, which describes the nature of radical innovation and its importance in this context.

1.4.2 The Nature of Radical Innovation

The word innovation comes from the latin term *innovare* and means to "make anew" or "alter". More recent definitions of innovation are much broader and involve not only the initial ideation of a new product or technology, but also the social, political and economic processes involved in new product adoption at individual, intra-organizational, inter-organizational and societal levels. Van de Ven and Angle (1989, p. 12) provide a definition that captures this perspective: "Invention is the creation of a new idea, but innovation is more encompassing and includes the process of developing and implementing a new idea." Another, even more succinct definition, is provided by Roberts (1988, p. 13) who states that "Innovation = Invention + Exploitation".

One major distinction made in the NPD literature regarding innovation is that between discontinuous and incremental innovation. According to Veryzer (1998, p. 306):

> Innovations can be thought of as falling on a continuum from evolutionary or 'continuous' to revolutionary or 'discontinuous'. Discontinuous innovation has been discussed in a variety of ways. Terms such as 'radical', 'breakthrough', 'revolutionary', 'really new', 'game changing', and 'boundary expanding' have all been used to refer to products that involve dramatic departures from existent products or their logical extensions.

Focusing on the extreme ends of this continuum, one can conclude that incremental innovation reinforces the capabilities and established technologies of organizations, while radical innovation forces them to ask new questions, to draw on new technical and

commercial skills, and to employ new problem-solving approaches (Burns & Stalker, 1961; Ettlie, Bridges & O'Keefe, 1984; Hage, 1980; Tushman & Anderson, 1986). According to Henderson and Clark (1990, p. 9):

> Incremental innovation tends to reinforce the competitive positions of established firms since it builds on their core competencies. In contrast, radical innovation creates unmistakable challenges for established firms, since it destroys the usefulness of their existing capabilities.

Generally speaking, radical innovation has been defined as a product that is new both to the firm and to the marketplace (Ansoff, 1957; Balachandra & Friar, 1997; Booz, Allen & Hamilton, 1982; Crawford, 1997; Kleinschmidt & Cooper, 1991; Roberts & Berry, 1985; Veryzer, 1998; Wheelwright & Clark, 1992). Recent theory additionally suggests that when individuals recognize new technologies and bring them into the firm, this is also an important component of radical innovation (Burgelman & Sayles, 1986; Colarelli O'Connor & Rice, 2001; Crossan, Lane & White, 1999, Reid & de Brentani, 2004).

Operationally, Colarelli O'Connor and Veryzer (2001) suggest that a radical innovation project must be viewed by the firm as having the potential to offer unprecedented performance features or embody elements that offer major potential such as: 5-to-10-fold improvement in performance or at least a 30% reduction in cost. Radical innovations have also been defined as innovations that embody a new technology that results in the development of new market and technological infrastructures (Colarelli O'Connor, 1998; Garcia & Calantone, 2002; Song & Montoya-Weiss, 1998).

1.4.3 The Diffusion of Radical Innovation: An Emergent Process

As noted above, incremental new products deal with the familiar, while discontinuous innovations entail radical technologies and markets, which may require that firms develop

new problem-solving approaches (Burns & Stalker, 1961). Most notably, incremental and radical innovations appear to differ in the way in which problems are structured and information searches are initiated. These propositions, regarding the way radical innovations are adopted by firms, correspond with the findings of Burgelman and Sayles (1986), Colarelli O'Connor and Veryzer (2001), and Colarelli O'Connor and Rice (2001). "Emergent" problem structures are characteristic of the origins of radical new product development (Bower, 1970; Burgelman & Sayles, 1986), where idea/information flow tends to begin with individuals operating at the technical level and, through championing, emerge as formal projects supported by the organization.

This emergent process has also been referred to as a "bottom-up process" (Burgelman & Sayles, 1986) because idea evaluation starts at the individual technical level, moves upwards to small-groups or teams operating at the product level, and then potentially (if approved) on to the project-level for implementation (Colarelli O'Connor & Veryzer, 2001; Crossan, Lane & White, 1999). Project formalization then leads to a flow of ideas to the organizational level. Burgelman and Sayles (1986, p. 31) note this process, which they have coined "up from below":

> Understandably we think of strategy formulation as top management work. Most employees, even quite high-level managerial employees, take the goals of the business as a given. But in the high-technology world, strategy often revolves around the innovation activities of relatively low-level technical and business people. To be sure, their decisions will require ratification by top management. Nevertheless...the reality is that those closer to the emerging technology will seek to define the business opportunity.

In comparison, for incremental innovations, because firms are dealing with familiar technologies and markets, the problem-solving process is likely to be structured the other way

around. In other words, broad strategies and objectives for management tend to start at the organization level and then are sent out to individuals for information gathering in the environment, utilizing a variety of traditional market research and analysis techniques (Urban & Hauser, 1993). Due to early involvement of upper management with problem structuring in the case of incremental innovation, it is likely that the organization is involved with directing information search efforts throughout the entire incremental process. Alternatively, as suggested in the bottom-up model (see also Reid & de Brentani, 2004), information regarding radical innovations is typically unstructured and brought into the organization by individuals who were not given specific directions in this regard by the organization. Indeed, much of the early information search effort for radical innovations may be driven by one or a very small number of individuals, without involvement or knowledge of a larger number of people, particularly those operating at higher organizational levels. As such, the role of the individual takes on a heightened importance for radical innovations, particularly during the early stages of the FFE of NPD prior to project formalization.

1.4.4 Market Vision and the Radical Innovation Context

For incremental new product ventures (e.g., improvements, adaptations, etc.), activities and decisions are typically part of an overt plan geared to achieving relatively well-understood and specific market applications. In contrast, for radical innovations involving advanced technologies, companies must depend on a much more complex and nebulous image of the future—a Market Vision—on which to base new product decisions, including the selection of an appropriate product-market application. Further, it is at the front-end of radical innovation—i.e., the FFE of the NPD process—that establishing a Market Vision is most difficult and where companies have the least capability in this regard (Gupta & Wilemon, 1996). Therefore, building an understanding of Market Vision—the focus of this dissertation—strengthens our understanding of the FFE in the case of radical innovations and will help companies to make better decisions in this particular scenario.

1.5 Importance and Rationale of Dissertation

As noted above, uncertainty at the fuzzy front-end is greatest in the case of radical innovation. This makes the research stream focusing on discontinuous new product development important. Market Visioning Competence, and the Market Vision it results in, are particularly relevant for enhancing the success of the FFE because they play a key role in guiding the firm along the appropriate path for a given technology when developing radically-new high-tech products.

Radical innovation claims to be the root of only 10% of all new products (Griffin, 1997), yet has been shown to result in much more than proportional gains in long-term corporate advantage and profitability (Ettlie, 2000; Ettlie & Rubenstein, 1987; Kleinschmidt & Cooper, 1991; Mansfield & Wagner, 1975; Tushman & Anderson, 1986). Given, however, that early-stage efforts in the firm to link advanced technology to market opportunities are typically frought with challenges, risks, and failure, many firms question whether it makes sense to become involved with radical innovation. At the same time, firms that do not engage in radical innovation, but rather focus on "continuous" new product development, are plagued with short timeframe competitive pressures, incremental growth and stagnant product lines (Colarelli O'Connor & Veryzer, 2001). On the whole, companies tend to be risk-averse, wary of the high cost associated with radical innovation, and also have a low propensity for cannibalizing specialized past investments (Chandy, 1996). Companies find it difficult to carry forward with potentially long-term product development when profitability is not clearly foreseeable and markets do not yet exist. In particular, managers in large firms may have trouble seeing the potential of "disruptive", "discontinuous", or radical, technologies (Burgelman, 1983; Christensen, 1997; Kanter, 1989) because the market implications may be obscured by the high levels of risk and uncertainty surrounding the technology (Colarelli O'Connor, 1998; Veryzer, 1998). It is proposed in this dissertation, that learning about how to foster and improve Market Visioning Competence and, resulting Market Vision, can help firms to alleviate

some of these concerns and to improve their ability to handle the risks associated with radical innovation. This is expressed by Colarelli O'Connor and Veryzer (2001, p. 231):

> Appreciating the implications of any disruptive technology for marketplace growth and corporate renewal is a large part of the innovation challenge (Christensen, 1997). Key to this effort is the ability to link advanced technologies to market opportunities of the future so that the project may be guided and motivated across the normal twists and turns that high uncertainty projects inevitably encounter. Yet this skill has been cited as one of the primary problem areas that can 'go wrong' in the product development and commercialization chain (Jolly, 1997; Lynn, Morone & Paulson, 1996).

This dissertation seeks to demonstrate that a strong Market Vision and excellent Market Visioning Competence can help firms to move away from the risk-averse, continuous end of the innovation spectrum in a way that improves their chances of achieving success in the much more profitable, although drastically altered, playing field of radical innovation. The outlook is that the pace of technological innovation will substantially increase both in terms of the frequency and the radicalness of product innovation (Chandy, 1996; Chandy & Tellis, 2000). Hence, it is essential that firms prepare for this more turbulent competitive scenario. The anticipated greater levels of radical innovation will provide an opportune environment for those companies that have learned how to improve their ability to create a mental picture or vision of a product-market which has direction and focus. This Market Visioning Competence and resultant Market Vision, can play an important role in reducing the level of uncertainty surrounding an innovation and in improving the chances for success (Kleinschmidt & Cooper, 1991; Leifer *et al.,* 2000).

While highly desirable for technically innovative firms, competence in the market visioning activity and in creating a Market Vision capable of informing members of the

firm how to successfully approach the market place (or, in other words, an "effective Market Vision") are extremely difficult to achieve (Jolly, 1997; Lynn *et al.,* 1996). The research that is presented in this dissertation responds to this problem in several ways. First, the findings should lead to a better understanding and appreciation of what Market Vision and Market Visioning Competence are through the identification and operationalization of the various dimensions comprising each. In this way, management will be in a better position to assess their firm's competence in developing market visions, as well as the appropriateness of the market vision(s) they have in place. Awareness of weaknesses/strengths in the dimensions comprising each of these concepts, as they pertain to Market Vision and Market Visioning Competence in a given firm, can allow companies to methodically evaluate and potentially improve their capabilities in this regard. This can lead to a reduction of the high levels of market uncertainty associated with the development of radically-new high-tech products. Indeed, the longer-run impact of this research can be to improve the overall performance of companies committed to innovating at the discontinuous end of the innovation spectrum. By improving their competence in the market visioning process and hence the strength of their market visions, companies should be able to achieve higher degrees of success.

In addition to the managerial relevance of this research, there are also important reasons from a theoretical standpoint. One of these is to develop an improved paradigm for the factors that lead to successful new product performance by distinguishing between those which are relevant to incrementally-new products and those that relate to the radical innovation scenario. The key factors that influence success in the case of incrementally-new products have been well researched by marketing scholars. Consistently, a key finding in NPD success factor studies—studies that deal primarily with incremental products—has been the need for a *unique, product advantage in the eyes of the customer* (Balachandra & Friar, 1997; Cooper, 1979; Lilien & Yoon, 1989; Mahajan & Wind 1992; Maidique & Zirger, 1984; Rubenstein *et al.*, 1976). A second success factor regularly cited

is having an *up-front strategy* in place to guide the new product effort (Cooper & Kleinschmidt, 1995; Cooper, 1996; Griffin, 1997). According to Booz, Allen, and Hamilton (1982, p. 10), "the new product strategy development step provides a focus for the idea-generation step in that the ideas and concepts generated are developed to meet strategic objectives." The importance of having an up-front strategy to guide NPD is also suggested by Crawford's (1980) "Product Innovation Charter". These two key success factors—i.e., unique product advantage in the eyes of the customer and the importance of having an up-front strategy—however, primarily relate to the early stages of the NPD process for incremental new products. This is because not only is the market known for these types of innovations, but corporate-level strategy is usually a precursor to the ideation process, where known customers are often involved in providing and/or evaluating ideas (Booz *et al.,* 1982; Cooper, 1979; 1984; Couger, 1995; Hughes & Chafin, 1996; Ulrich & Eppinger, 1995; and Urban & Hauser, 1993). In the radical innovation context, however, the market is often unknown in the early stages of the FFE of NPD and/or current customers will not be relevant for the products that will be developed from the radical technology (Christensen, 1997). Further, having an "up-front" strategy may be not possible with a process that is largely emergent, as is the case with radical innovation (Burgelman & Sayles, 1986). As such, this evidence suggests that these success factors are less relevant in the radical innovation context. The next question that naturally arises, therefore, is whether either of these two key success factors—unique, product advantage in the eyes of the customer or up-front strategy—also plays a role in radical innovation.

In the case of radically-new products—that is, those based on innovation with technologies that are new to the firm and to the marketplace, and those involving changes in both technical and marketplace infrastructures—factors for success are not as well understood and have been the focus of much less research. This is related to a limited understanding of the information flows and decision-making processes of individuals involved at the fuzzy front-end of NPD dealing with radical innovation. The findings of

Song and Montoya-Weiss (1998) indicate that, while strategic planning also plays an important role in determining success for radical products, companies are not very proficient at it. Therefore, one gap in the literature is that few unique aspects of strategy have been identified that can be used specifically with radical innovation. As will be described in Chapter Two of this dissertation, Market Vision is a component of strategy which can be used in the radical innovation case with new technology because the process is emergent and is able to begin with one individual. Further, Song and Montoya-Weiss (1998) demonstrate that for really new products, customer needs are often poorly articulated and as a result detailed market studies are of limited value. In fact, there is evidence to indicate that traditional market opportunity analysis can have a negative impact on profitability because such analyses, in the radical innovation case, represent an inaccurate form of learning about the market. A second gap that needs to be filled in the literature, regarding success factors for radical innovation, involves finding out what forms of market learning are specifically appropriate in this case.

Another potential theoretical contribution of this research is to develop a better understanding of the different phases and activities related to the fuzzy front-end for discontinuous innovations. Khurana and Rosenthal (1998), Moenaert *et al.* (1995), and Reinertsen (1999) have laid some of the groundwork for a better understanding of the later stages of the FFE by examining key issues related to this part of the product process and their impact on product innovation success. Specifically, Khurana and Rosenthal (1998) focused on the importance of structured strategy for dealing with new product opportunities at the fuzzy front-end; Moeneart *et al.* (1995) examined the importance of communication at the R&D/Marketing interface for ensuring better concept development at the fuzzy front-end; and Reinertsen (1999) investigated the importance of optimizing the FFE process by speeding up decision-making and screening, all to a view of improving chances of success. With the exception of the Moenaert *et al.* (1995) research, however, which had a heterogeneous sample of innovation types, past studies have focused

primarily on incremental innovations (e.g., product evolutions, improvements, adaptations, etc.), where decisions and activities tend to be more explicit and structured, and where corporate-level strategy is usually a pre-cursor to the ideation process (Booz, Allen & Hamilton, 1982; Urban & Hauser, 1993). Moreover, in the case of discontinuous innovations, these types of decisions and activities (e.g., early interaction between R&D/marketing, pre-screening, etc.) are typically relevant only to the later stages of the fuzzy front-end—that is, the ideas have moved into the sphere of corporate consciousness. This leaves an important gap to fill regarding our understanding of what happens in the early stages of the fuzzy front-end for discontinuous innovation where management influence and control have been shown to be most elusive. This gap has been highlighted by Colarelli O'Connor and Veryzer (2001), who call for empirical studies in the area of *market visioning* in order to help firms and academics to better understand this process and to develop a higher level of competence in this regard.

In general, the importance of developing theory to support research on the early stages of the fuzzy front-end for discontinuous innovations has been emphasized by key institutions and researchers in the NPD field. For example, the Marketing Science Institute, in its 2004 – 2006 Research Priorities, lists the study of early prediction of future markets (e.g., scenarios), ensuring customer-relevant innovation at all stages of NPD and, discontinuous growth strategies that reshape industry as three of its top-tier priorities; each which is relevant to this dissertation. Additionally, Griffin (2001, p. 218), notes that "market visioning is crucial for helping firms uncover the directions in which developing technologies should be managed, and those that should be avoided", and a "significant amount of research remains (to be done) in trying to determine which flows and themes are associated with increased probabilities of project success". Given the importance, yet lack of knowledge, regarding Market Vision and Market Visioning Competence and, given the general call for research in this area, these topic areas have recently become an important focal point for researchers and marketing practitioners alike.

This dissertation responds to the need and call for research to address these crucial gaps in our understanding of the fuzzy front-end of radical innovation. It deals with the information flow and decision making processes, which are related to Market Visioning Competence and with the resulting mental models which comprise Market Vision, and show how these are potentially linked to new product success. Market Visioning Competence and Market Vision are considered to occur in the early phases of the FFE, prior to project formalization, and they are also viewed as providing essential information for decision makers at the project screening step of NPD (Colarelli O'Connor & Veryzer, 2001). As such, developing a better understanding of these two key concepts can help to facilitate better comprehension of the FFE in general, and also aid in moving potential projects from the FFE to a formalized project involving a radical innovation.

In sum, the focus of this dissertation is to understand what Market Vision and Market Visioning Competence are, and to explore and test their interrelationship and their impact on early firm performance in the development of radically-new, high-tech products. By creating greater transparency and insight about the nature of these concepts and about how they are linked to new product performance, it is hoped that both academics and managers can improve how they cope with and benefit from the predicted increase in the extent of radical innovation in the future.

1.6 Objectives of the Dissertation

The research underlying this dissertation focuses on the concept of Market Vision and investigates the nature of the Market Visioning Competence required to develop effective Market Vision. The combined and separate impacts of these important constructs on performance are investigated. It is believed that both Market Visioning Competence and Market Vision are proactive constructs, which individuals may impact and improve through a better understanding of the specific dimensions which comprise them. As such, this dissertation has two primary goals: (1) theory construction and development, and

(2) improving insight and understanding of Market Vision and Market Visioning Competence for management.

First, through theory construction and theory extension, this dissertation aims to develop a better understanding of the concepts of Market Vision and Market Visioning Competence, the relationship between these two, as well as their impact on performance in the development of discontinuous new products. To this end, the first part of the research focuses on exploring and expanding our knowledge of the variables that foster and are a part of successful Market Vision for radically-new, high-tech products, and also, moving towards a disentangling of the domains of Market Visioning Competence and Market Vision. To facilitate this objective, measurement tools are constructed in order to allow for improved conceptualization and estimation of the concepts of Market Vision and Market Visioning Competence. Further, another important area of theory addressed in this dissertation is the question of how to measure performance for new products that are still in the FFE of the NPD process.

The results of the analyses in this dissertation complement and enhance the findings of previous research. For Market Visioning Competence, the work of Colarelli O'Connor and Veryzer (2001), Howell and Shea (2001), Granovetter (1973), Burt (1992) and Narver *et al.* (2000) has been instructive for developing an understanding of the relevant individual and organizational dimensions. For Market Vision, the work of Hamel and Prahalad (1994), Lynn and Akgün (2001), and Collins and Porras (1995) helps in building an understanding of the critical intrinsic and extrinsic dimensions of the concept of Market Vision. Finally, in order to develop insights about the likelihood of new product success at the fuzzy front-end of NPD, this research required an *Early Performance* metric. Because Market Vision deals with the very early stages of radical innovation involving advanced technology, the standard measures of performance were inappropriate (see Griffin & Page 1996). This is because most deal with the post-project phase of a new product. One of the challenges, therefore, is that on the one hand it is obviously important

to make decisions that will lead to strong Early Performance; at the same time, only limited theory exists regarding how to evaluate performance during and as a result of activities in the FFE. In light of these concerns, Von Hippel's (1978) "lead user" concept and Griffin and Page's (1996) "technical competitive advantage", provide insights for developing the Early Performance metric for radical innovation. These concepts will be described in more detail in Chapter Two.

A second goal of the dissertation is of a more practical scope. The scales which will be developed to measure Market Vision and Market Visioning Competence, in conjunction with metrics for Early Performance, will help managers better understand the concepts of Market Vision and Market Visioning Competence with a view to implementing these within the organization. In this way, managers will have access to knowledge regarding how to improve each, in order to create better chances of market success for their firm when developing radically-new, high-tech products. To this end, an important part of the research in this dissertation involves testing whether Market Vision and Market Visioning Competence are critical for Early Performance, under varying environmental and firm conditions. In this way, managers will be able to gain an understanding of not only how to foster Market Visioning Competence and Market Vision, but also how to foster the conditions under which these constructs have their greatest chance of impacting early firm performance.

1.7 The Roadmap

In Chapter One, the key concepts of Market Vision and Market Visioning Competence were introduced. Further, these concepts were discussed in light of their relevance in the fuzzy front-end of the NPD process for radical innovation, and their importance for achieving new product success for firms involved at this end of the innovation spectrum. In Chapter Two, the extant literature required for exploring and developing an in-depth understanding of the primary concepts—that is, Market Vision, Market Visioning

Competence and Early Performance—as they relate to radical innovations and the FFE, is presented. The literature covered integrates ideas from different academic disciplines including economics, management, marketing, and new product development. Once these foundations are described, some of the limitations of previous studies are discussed and research gaps are highlighted. This points the way for the remainder of the research in this dissertation.

Based on the theoretical discussion in Chapter Two, the main dimensions and interactions between concepts involved with Market Vision, Market Visioning Competence and Early Performance, as they relate to radical innovation, are conceptualized and modelled in Chapter Three. Each concept is defined, the central role of Market Vision is presented, and measurement issues are considered. Formal hypotheses are presented regarding the operationalization of Market Vision, antecedent Market Visioning Competence and Early Performance and then the relationships between these central constructs are hypothesized. Several potential moderators are also introduced and formal hypotheses posited.

In Chapter Four, the measurement hypotheses developed in Chapter Three are tested empirically. First, the methodologies utilized for the scale development for Market Vision, for Market Visioning Competence and for Early Performance are detailed. Second, the results for dimensionality, reliability and validity are presented and discussed.

Chapter Five presents the results of the empirical testing of the model which was developed in Chapter Three. The scales developed and tested in Chapter Four are utilized for measurement purposes in the empirical testing of this model. The results from the empirical structural model and moderating effects of that model are then discussed.

Chapter Six summarizes the key contributions of this research to the field of marketing, both theoretical and practical, and potential managerial implications are discussed. Finally, limitations of the study are provided along with ideas for future research.

Chapter 2: Theoretical Foundations

To develop the conceptual model which will be tested empirically in this dissertation, it is necessary to first examine the theoretical underpinnings that are likely to impact the composition of and relationships between the key concepts of interest in this study. These concepts, Market Vision and Market Visioning Competence are hypothesized in this dissertation to be related to the ability of firms to successfully link technologies to market applications of the future, as indicated by the Early Performance of these ventures. These concepts and relationships comprise an important part of the fuzzy front-end—that is, the early process of a firm's involvement with a radical innovation. Various perspectives have been used to study the topic of innovation and these primarily emanate from the disciplines of economics, management, and marketing. This dissertation builds on the historical roots of the study of radical innovation from these various perspectives.

2.1 Three Perspectives of Innovation

First, the *economics perspective* will be utilized to provide a broad understanding of the role that innovation plays in driving economic performance. Researchers in the field of economics have typically studied the relationship between innovation and performance by examining technology life cycles and how they play out across industries and countries. The economics perspective therefore provides a macro-environment for understanding innovation dynamics beyond that of a single firm or organization. Two key economic theories provide insight into how and why there is a link between innovation and performance. The first of these is "new growth theory" (see section 2.1.1 for more details) which looks specifically at how technology and innovation play a key role in the economic growth process. Second, "evolutionary theory" (see section 2.1.2) provides a broad level of understanding regarding how radical and incremental innovations are related, and how innovations diffuse through firms and their environments (see section 2.1.3). In particular,

"co-evolutionary theory" (firms and environments evolving together) allows us to understand the macro-level processes through which thriving firms are able to maintain successful positions in their changing environments (see section 2.1.2).

The *management perspective*, particularly that of scholars of technology and innovation management (TIM), has taken two approaches to theorizing about innovation. First, TIM scholars have drawn heavily on the work of economists, where industry and country aspects are viewed as impacting innovation. Utilizing this macro level of understanding, the management perspective has contributed to evolutionary theory (section 2.1.2) and to the diffusion and adoption literature (section 2.1.3). Second, TIM scholars have examined the function of individuals who play key roles in supporting and forwarding innovations within networks and firms, particularly during the fuzzy front-end of discontinuous innovation. These individuals are particularly relevant for developing an understanding of certain key elements comprising Market Visioning Competence; that is, for Networking (section 2.1.4) and for Idea Driving (section 2.1.5).

The *marketing perspective*, held primarily within the new product development (NPD) field, also examines innovation process activities from the individual level (thereby contributing to the discussions in sections 2.1.4 and 2.1.5 on Networking and Idea Driving), but additionally has used an organizational view, which is focused on product-, project-, and firm-level processes that contribute to the organization's success in creating, developing and marketing new products. The organizational view contributes to our understanding of diffusion and adoption (section 2.1.3), and also, covers the zones of organizational learning and, more specifically market learning (sections 2.1.6 and 2.1.7), which is another key component of Market Visioning Competence.

2.1.1 New Growth Theory

Rosenberg (1976) describes Schumpeter's contribution to the field of innovation eloquently in his comment that the study of technological innovation consists of a series

of footnotes upon Schumpeter. Schumpeter (1911) was one of the first economists to study innovation and to show its impact on the economy. As a 28 year-old, Schumpeter completed an influential book, *The Theory of Economic Development*, published at first in German (1911), later in English (1934) among other languages. The book was best known for describing the process of "creative destruction" whereby successful innovations displaced inferior technologies and through imitation and learning were spread throughout the economic system. Scherer describes the two main contributions of the book as follows (1999, p. 27):

> The book advanced two main themes. First, innovation—including the introduction of new products and production methods, the opening of new markets, the development of new supply sources, and the creation of new industrial organization forms—lay at the heart of economic development, facilitating the growth of material prosperity. Second, innovations did not just happen, but required acts of entrepreneurship—heroic efforts to break out of static economic routines.

These two theories put forward by Schumpeter about what it takes to achieve innovation are critical to understanding why radical innovation is important to the study at hand. The theories suggest that active involvement with radical innovation impacts performance (product, firm and economy levels), and also that individuals operating in various roles are paramount in making this happen.

According to Schumpeter (1911), entrepreneurs or capitalists are each necessary for the development of "new combinations". The entrepreneur's function is to combine the productive factors (i.e., technology, labour), while the capitalist is responsible for the financing of the effort through credit or lending. Schumpeter believed that the majority of

[1] Entrepreneurship processes occurring inside incumbent organizations have been coined intrapreneurship" by Rubenstein (1994).

innovations are new combinations drawn from the means of production of old combinations. This command over the means of production for carrying out new combinations could be facilitated in one of two ways. First, size can be leveraged to provide economies of scale in order to have the means of production and support for intra/entrepreneurs.[1] Second, venture capital can be used to fuel the actions of the intra/entrepreneur. This notion of the involvement of both capitalists and intra/entrepreneurs is important to this research. Individual intrapreneurs, or "champions", are usually the drivers of firm-level involvement with radical innovations (Schon, 1963; 1967; Howell & Higgins, 1990; Howell & Shea, 2001; Bower, 1970; Burgelman & Sayles, 1986; Colarelli O'Connor & Rice, 2001; Colarelli O'Connor & Veryzer, 2001) and driving new ideas through "championing" is considered to be an important component of Market Visioning Competence (Colarelli O'Connor & Veryzer, 2001). Further, the ability to attract venture capital, is considered to be an important early indicator of performance in this research (Zider, 1998).

Stanford economist Paul M. Romer (e.g., 1990) and Kennedy School of Government professor Frederic M. Scherer (e.g., 1999) have carried on in the Schumpeterian tradition by showing that technological discoveries are the driving engine of economic growth. In sharp contrast to neo-classical growth theory, the *new growth theory* of Schumpeter, Romer and Scherer does not treat technological change as a "black box". Rather, it studies the factors that are endogenous to the growth process such as human capital, investment in R&D, capital equipment and the public research infrastructure. As noted by Freeman (1987, p.5), another pre-eminent economist, "technical and related social innovations are the main source of dynamism and instability in the world economy and that technological capacity is the main source of the competitive strength of firms and nations."

A further theme advanced by Schumpeter includes the notion that society's needs and wants are brought together with the economic process through technology.

He considered these phenomena to be incidents of a distinct "equilibrium process". This dissertation suggests that a fulcrum for this equilibrium process is provided by Market Vision, because it provides a mental map that enables the linkage between technologies and markets.

2.1.2 Evolutionary Theory

Closely related to new growth theory is a stream of economic theory based on evolutionary models (Nelson & Winter, 1982). In an attempt to better understand the developments of organizational structure and strategy, many of the concepts and theories of evolution and natural selection have been borrowed by organizational ecologists from the biological domain. Baum and Singh (1994) describe the greatest similarity between the two domains (organizational and biological) as natural selection, a very general mechanism likely to operate in any system of inheritance where variation in form is related to variation in survival and replication. In other words, organizational forms with the highest probability of being transmitted to the next generation will tend to increase in number.

According to Nelson and Winter (1982, p. 14), "the core concern of evolutionary theory is with the dynamic process by which firm behaviour patterns and market outcomes are jointly determined over time." In other words, under given environmental conditions and given certain resources, including a set of technologies available to a firm at any given time, firms search for new ideas and implement these with varying levels of success. This, in turn, determines the population level variance or, in other words, variance at the industry level. The environment then selects and retains those firms which have sets of skills and core competencies which "best fit" the environment.

Building on the work of Eldredge and Gould (1972), Nelson and Winter (1982), and Sahal (1981), Tushman and Anderson (1986) argue that technologies evolve through long periods of incremental change, punctuated by breakthroughs that either enhance or destroy competencies of existing firms. Evolutionary theory highlights this salient feature

of the innovation process—that innovation changes the measure of production very slowly over time and is rarely punctuated by rapid change. As such, radical innovation and the radically-new products that it spawns are quite rare, and can change the ground rules for incumbents in the case of competence-destroying technology. Eldredge and Gould (1972) call this process "punctuated equilibrium".

Bahrami and Evans (1987) describe the periods of technological upheaval that follow a punctuation event as occurring in "waves". Such occurrences are related to the response of firms to new environmental opportunities. Failure or successful outcomes are related to deficiencies or competencies of organizational forms in reaction to new environments (Hannan & Freeman, 1977; 1989). In addition, the innovative changes brought about by competent organizations in response to new environments may, in turn, impact the learning environment, thus creating further "variance" (Baum, 1990; Baum & Oliver, 1991; Singh, House & Tucker, 1986).

There are striking similarities between technological evolution in organizations and evolution in nature as regards the processes of variation and selection, as have been described. There are, however, also many weaknesses and, in some cases, oversimplifications in the comparison. For example, Levinthal (1994) describes an evolutionary orientation as being too "deterministic" with its focus on adaptation, re-orientation and selection. Such a traditional ecological perspective, as forwarded by Hannan and Freeman (1989), gives primary emphasis to the influence of external selection processes on the dynamics of organizational diversity—a true "contingency" approach. This population ecology version of evolutionary theory asserts that organizations are inertial. The concern of Levinthal (1994) and others is that a pure focus only on the impact of the environment on the firm does not leave much room for a more voluntaristic orientation where learning, change and voluntary adaptation play important roles. Some of the key aspects of such learning include decentralization and employee empowerment, driving the quest for improvement down the hierarchy to where relevant resources of

knowledge and imagination reside (Winter, 1994). This has often been shown to be the case with radical innovation (Burgelman & Sayles, 1986). This "internal evolution" perspective, however, is a closed-system and leans heavily toward a voluntaristic orientation, to the exclusion of external determination.

It is important to realize that the 'chicken versus egg' perspective of evolution, when it comes to innovation, is misleading. Rather, the "co-evolutionary" view recently forwarded by several evolutionary theorists (Baum & Singh, 1994; Rosenkopf & Tushman, 1994; Van de Ven & Garud, 1994) appears to be much more realistic. This point of view posits that both external (or 'environmental') and internal (or 'firm') factors influence firm and industry development. It also suggests that one side of the equation does not necessarily dominate the other in terms of cause and effect. Rather, the co-evolutionary perspective proposes that both the firm environment and the firm itself influence the trajectory of firm development, in concert.

As such, it is important to examine both the external (environmental) and internal (firm) factors, which are likely to have the most impact on a firm's development, in a way that leads to success with radical innovations. It is believed that, in the radical case, building a Market Vision through Market Visioning Competence involves both external and internal factors related to success with radical innovation, some of which are considered to be driven primarily by individual capabilities and some which are driven mostly by organizational capabilities. In this dissertation, those internal and external factors, which offer the firm the best shot at early success under the radical innovation scenario, are of particular interest. For example, new ideas are often encountered by individuals working for firms, but in their external environment; therefore, interaction with networks is an important individual external factor. The way in which new ideas are then championed once inside the firm, largely relies on individual capabilities operating with the firm. Dealing with markets, on the other hand, primarily involves firm level capabilities, which occur both internally and externally to the firm. For example, interplay between the market and

the firm involves both the ability to recognize potential future needs through a strong orientation to and understanding of that market (which is developed by "being out there" with the customers and reinforcing the orientation within the firm), and also, specific tools (developed internally and utilized/applied externally) are required to learn about the market. There are also several other internal and external factors suggested by the literature that might play a moderating role on the relationship between Market Visioning Competence and Market Vision, and ultimately, on their ability to impact Early Performance. These will also be examined in the context of this dissertation.

2.1.3 Diffusion and Adoption Theory

The focus of scholars from economics, management and marketing on organizations and how they co-evolve with their environments, both market and technological, allows us to witness the processes of "diffusion" and "adoption". Diffusion and adoption are social processes (Rogers & Shoemaker, 1971) through which "generic" technology life cycles (at the macro level; those required to manufacture products which are widely held by all participants in an industry (Goodman & Lawless, 1994)), platform life cycles and product life cycles are progressively linked. As described previously, a technology life cycle measures the rate of a given technology's progress or potential for improvement resulting from a given amount of engineering effort at the macro level. Platform life cycles (Wheelwright & Clark, 1992) are related to the technological progress toward a set of potential applications and related products for a specific technology. A platform usually exists at the company level. The product life cycle is a description of forces at work in the market that influence a given product's sales and margins over the time it is available to the market (Webster, 1991). The diffusion of a "generic" technology through its life cycle usually occurs through one or more platform life cycles and sub-set product life cycles. This is so because generic technologies are usually capable of having several applications or platforms, which in turn may be related to several further products at the generational

level (Wheelwright & Clark, 1992). It is therefore appropriate to consider both product and platform life cycles as sub-sets of technology trajectories.

Technology life cycles may last for extremely long periods of economic development and evolve incrementally through several applications, platforms and generations of various products, until a discontinuity disturbs the process and starts it again (Wheelwright & Clark, 1992). When a technological discontinuity occurs, the initial wave of innovation, platforms and products that stem from such an occurrence are usually radical in nature. Radical technologies often meet more resistance than incremental ones in terms of organizational adoption because of the uncertainties that are involved with them, and also because of inabilities to visualize how such new technologies might be incorporated into products and utilized in the marketplace (Rogers, 1983). The ability to visualize (Market Visioning Competence) this link (Market Vision) between technology and market application, however, tends to be a reflection of people working within those firms. These are individuals who are capable of overcoming resistance to uncertainty. They do so through their abilities to network externally to the firm, rally support for new ideas within the firm, contribute to proactive market learning capabilities and develop good Market Learning Tools. As such, Market Visioning Competence, which in this dissertation is considered to be a composite of these underlying capabilities, is proposed to serve as a facilitator of the organizational adoption process. This process determines, for the organization, which potential product application(s) will be pursued based on which technology(ies). Market Visioning Competence is proposed to facilitate the techno-market link between the platform-technology level (Technical Vision) and the product-market level (Market Vision). It should also be noted here that, in the case of competence-destroying technologies, new platforms are being developed. As such, the platform level in these cases is being initiated through the involvement with the technology that is new to the firm, and so, will not likely yet be recognized as a platform. Because the specific link of interest, in this dissertation, is that between Market Visioning Competence and

Market Vision the framework including prior Technical Vision and subsequent Project Vision (at the project level after project formalization) will not be investigated further or tested in the context of this dissertation (see Figure 2).

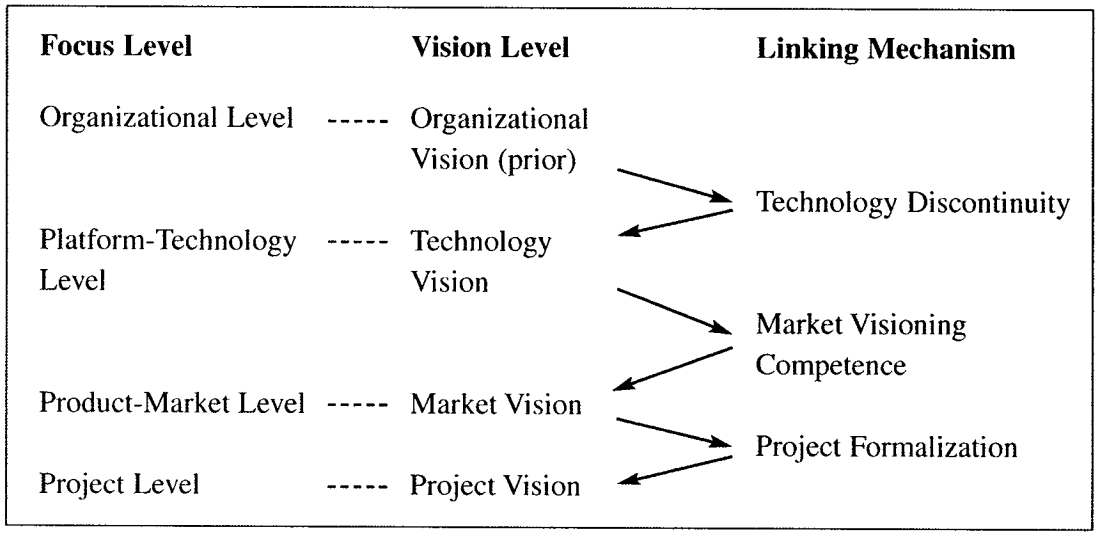

Figure 2. Framework of Levels of Vision Development and Linking Mechanisms

Lambkin and Day (1989) have proposed that, in order to capture an overall life cycle pattern, the product class is the most appropriate unit of analysis. It will be shown in the course of this dissertation that vision, as it pertains to the market, is focussed on the interface between a specific product and a specific market, and as such, the product life cycle is the most relevant level of analysis. The given technology, however, that underlies a specific product is what is constant throughout the entire chain of events of vision development (Figure 2). Therefore, we need to think of Market Vision as being a vision for a specific technology being developed toward a specific product for a specific market.

According to Lambkin and Day (1989), there are three factors which influence the pattern of product class sales over a life cycle: the demand system, the supply system and the resource environment. Traditionally, diffusion theory and adoption have been investigated from within the demand-side research stream (Bass, 1969; Mahajan & Muller, 1979; Mahajan & Wind, 1985; Rogers, 1983). Diffusion is seen as a process

whereby the members of the social system influence one another in direct and indirect ways (i.e., through demonstration that creates awareness, through providing information that shows viability of a new technology or product, through competitive pressure, etc.) (Rogers, 1983). Based on this perspective at the "market side" or "demand side", a market can therefore be thought of as a social system through which technologies and new products/services diffuse over time. The speed at which adoption occurs is largely impacted by the various attributes of innovation as characterized by Rogers (1983): relative advantage, complexity (and perceived risk), compatibility, trialability and observability. It is important to note that the "demand side" is made up not only of end-consumers for products and services, but also of business markets who purchase technologies and manufactured products "for use" (McDade, Olivia, & Pirsch, 2002).

While the supply-side research stream has largely focussed on normative strategy prescriptions from patterns of competitive behaviour at each stage of the Product Life Cycle (PLC) (Biggadike, 1981; Day, 1981; Kotler, 1984; Levitt, 1965; Rink & Swan, 1979; Schendel, 1986), Lambkin and Day (1989) have suggested that diffusion theory has only a slight relationship to the PLC. As a powerful addition to PLC theory, the supply-side offers further insights into the dynamics of organizational adoption and diffusion to the market. Several researchers have recently begun to examine the supply-side using this lens (for a review see Frambach, 1993). The adoption of a radical technology by a firm for manufacture (as opposed to for use, which occurs on the demand side), is facilitated by good networking, good market learning capabilities and people capable of overcoming resistance (Colarelli O'Connor & Veryzer, 2001). Additionally, there are three factors, which have been suggested in the literature as likely influencers of firm adoption of radical innovations: Origin Relatedness (Bolland & Hofer, 1998; Tushman & Anderson, 1986), Resource Availability (Bower, 1970; Burgelman & Sayles, 1986), and Firm Size (Burgelman & Sayles, 1986; Cohen & Levinthal, 1990; McDade, Olivia & Pirsch, 2002). Further, *technology factors* (Appropriability), *competitive environment factors* (Industry

Concentration, Incumbency, Reputation) and *firm-level factors* (R&D Expenditures, Marketing Expenditures) impact the demand-side of the diffusion and adoption equation (Robertson and Gatignon, 1986). All of the moderating factors will be described in more detail and reflected in the hypotheses to be presented in Chapter 3.

2.1.4 Network Theory

Firm networks provide an external orientation for firms and enable communication with the external environment (Robertson & Gatignon, 1986). Such networks are hypothesized in Chapter 3 to be intrinsic components of Market Visioning Competence. This is believed to be the case because part of Market Visioning Competence involves the networking required to adopt and develop new technologies (Colarelli O'Connor & Veryzer, 2001).

Modern complex technologies often display increasing returns (Arthur, 1989) to adoption in that the more they are adopted, the more experience is gained with them and the more they are improved. That is, the benefit of adopting a technology varies directly with the number of others who adopt the technology (Herbig, Howard & Kramer, 1995; Hunt & Morgan, 1996; Katz & Shapiro, 1985; Redmond, 1991). Thus, a technology that gains an early lead in adoption may eventually "corner the market" of potential adopters, with other technologies becoming locked out. The underlying structure of such a path-dependent process is based on network effects (Burt, 1992). Network effects, in the innovation realm, mean that decision-makers react to decisions of other decision makers—thereby becoming members of the same network—because they affect the chance that the initial choices made within the network are, or will turn out to be, advantageous (Burt, 1992). As such, there should be an inherent advantage to being part of a network where there is a high level of adoption. This in turn means that there is an advantage to being a central player in a broad network (Berkowitz, 1982; Scott, 1990).

This perspective suggests that the environment plays a critical role in the very early decisions made by individuals exposed to early technology information. This is likely related to individuals looking to the environment both to gain more information about a new technology and to see what the general adoption pattern seems to be, before bringing it to the attention of others within the firm (Hunt & Morgan, 1996). To understand this better, we can think of generic technology(ies) (in addition to base science) as being adopted/used by firms and then developed into application technologies, which are specific to the firm. As previously defined, generic technologies are those required to manufacture products and are widely held by all participants that get involved in the industry. Application technologies are those which distinguish the organization from the competition and which are systematically developed within the firm that is building on generic technologies (Goodman & Lawless, 1994). Therefore, application technologies provide the bases for firm-level variation and selection, from a co-evolutionary perspective. As such, a question that naturally arises is how generic technologies are adopted by firms and turned into application technologies. The ability to make these links between environment, firm, and markets in an effective way is related to Market Visioning Competence and, will be shown in the discussion following to be a function of individuals and their networks.

The idea that the fuzzy front-end involves processes of information gathering and adoption from the environment is based on the literature that demonstrates that the environment external to the firm is the primary source of new ideas for discontinuous innovations, and that even in-house ideas ultimately have some input from external sources (Allen, 1977; Burgelman & Sayles, 1986; Crossan *et al.,* 1999; Ettlie, 1976; Macdonald & Williams, 1994; Roos, 1996). This literature also underscores the importance of specific individuals working for firms in collecting this information through their networks from the environment. This perspective is summarized by Quinn (1985) who states that technology tends to advance through a series of random insights frequently

triggered by gratuitous interactions between the individual discoverer and the outside world. These interactions provide the new combinations of old elements, as described previously (Usher, 1929). In the case of discontinuous innovation, old elements usually come initially from an individual in the firm who has the idea to combine one or more technologies, which previously were unrelated in an important way (Burgelman & Sayles, 1986; Hargardon & Sutton, 1997). In other words, new-to-the-world products that expand the market tend to be initiated from outside the current industry but through individual and firm-level processes (Utterback, 1994). This literature is important to the discussion at hand because it demonstrates that firms and individuals within those firms can and do influence technological trajectories, particularly through their fuzzy front-end processes, which put an application "spin" on a generic technology. By doing so, firm members affect the way that a generic technology ultimately impacts the marketplace through competitive product delivery targeted towards specific applications.

In addition to breadth and centrality, which were described above as being important to adoption, variety in an individual's network also creates a scenario where there is a greater likelihood of unusual combinations. This idea builds on the "strength of weak ties" work of Granovetter (1973) and the work on "structural holes" of Burt (1992). These arguments assert that acquaintances or weak ties are less likely to be socially involved with one another than close friends or strong ties (Granovetter, 1973). In the case of structural holes, two non-redundant contacts come together in a network who have not been associated before; in other words, structural holes provide the most extreme situation of weak ties (Burt, 1992).

The theory goes that individuals with a limited number of weak ties will be more deprived of information from distant parts of the social system and will instead be confined to the views of their close friends. This deprivation insulates them from the latest ideas and therefore may put them in a disadvantaged position. On the other hand, while weak ties provide access to information and resources available beyond their close friends, strong ties

lead to greater helping behaviour and are usually more easily available (Granovetter, 1983). Therefore, different utilities are related to different ties (Pool, 1980). For example, access to new and different information and resources from weak ties may be important for gaining knowledge of new technologies, potential markets and other resources such as capital. The work of Burt (1992) has shown that the tendency for networks to deliver rents, or competitive advantage, is tied to the ability for firms to tap into non-redundant contacts between members of a given potential network. In other words, individuals who are able to make new links between previously unlinked individuals, which provide new insights, and do so ahead of the competition, are able to get new ideas for technology and market development ahead of the competition. Therefore, variety in networks is important. While variety and resultant new network links are important, so are centrality and strong links within a network. For example, the helping behaviour that stems from strong ties may be useful, once new knowledge has been gained, in building a dialogue within a community capable of furthering the understanding of the technology and creating a critical mass for adoption of a given market application. As such, in networking, both weak ties (variety and breadth) and strong ties (centrality) are likely to be strongly involved with linking advanced technologies to market opportunities of the future (Market Visioning Competence). Colarelli O'Connor and Veryzer (2001) and Lynn (1993) stress the importance of webs of external relationships to broaden a firm's thinking by giving an opportunity to draw on new and different areas of knowledge and on product application situations.

Based on the literature then we see that such webs, or networks, are the social facilitators of diffusion and adoption. These webs are particularly effective when the networks of a firm are broad and varied and when the key individuals from the firm are central in the networks. As such, these three aspects of Networking—variety, breadth and centrality—enable the successive linking of generic technologies to applications technologies, products and markets. This linking capability through networking is an important component of Market Visioning Competence.

2.1.5 Organizational Politics and Idea Driving

As was discussed with the co-evolutionary approach to understanding organizational dynamics (firms and environments evolving together interactively) (see section 2.1.2), the impact of technology on the organization is not completely deterministic in the sense that it controls organizational form, function, or strategy. As noted by Scarbrough and Corbett (1992), the relationship between technology and organizations is largely determined by managerial intentions and values (Buchanan & Boddy, 1983), as well as organizational politics (Pettigrew, 1973).

Frost and Egri (1991) describe organizational politics as involving contests among individuals working for organizations (or what Frost & Egri (1991) call "actors"), which include two fundamental activities of organizational life. The first activities involve the struggles for collaboration among actors in the performance of organizational work when the means-ends for getting it done are unclear and/or subject to dispute (Barnard, 1938; Pfeffer, 1981; Thompson, 1967; Wilkinson, 1983). Second, actors are motivated by different self-interests and preferences as they strive to acquire, manage and control resources (Baldridge, 1971; Cyert & March, 1963).

Related to the first point, as we have seen, radical innovation provides a context with high levels of uncertainty. Therefore, the tasks of actors are likely to be ambiguous and a common path to move forward unclear. Empirical research indicates that political gamesmanship is most likely to be positively correlated with the level of innovation originality (Pelz, 1983; Pelz & Munson, 1982), perceived risk and complexity (Fidler & Johnson, 1984). Drawing on the second point, radical innovation also typically engages human actors who have different interests and perspectives and who stand to gain or lose as a result of involvement with a particular innovation (Frost & Egri, 1991). Therefore, in the case of radical innovation, high levels of organizational politicking by individuals are likely.

Political activity, in the business literature, has been treated largely as an obstacle. For example, Argyris' (1990) description of organizational politics as an obstruction to

organizational learning is widely accepted. According to Argyris, in order to defend against the fear of embarrassing themselves and/or hurting others, people have a tendency to render contentious matters non-discussable. As a result, people often reveal only what they really think and feel in informal settings behind closed doors by engaging in personal politicking. Given the lack of formality and reduction of information flow likely to occur in such situations, organizational learning may indeed by hindered. However, while Argyris suggests that politicking may be at odds with learning processes, well-focused politicking or, put in another way, championing has actually been shown to be an important component of driving new and contentious ideas in the case of radical innovation (Howell & Higgins, 1990; Howell & Shea, 2001). Not only is politicking important but, in particular, it must be convincing because radical innovations, in general, have lower levels of acceptance (Frost & Egri, 1991).

Organizational learning, therefore, may actually be facilitated, particularly at an informal level by politicking, as long as it is focused and driven by a strong champion of innovation. As such, it is possible to see the importance of politicking in the form of focused idea driving as part of the early competence involved with forming a vision related to the radical innovation that will be accepted at the more formal project and organizational levels. In other words, as described by Mintzberg (1983), it takes will and skill to successfully enact political action.

2.1.6 Organizational Learning

Organizational learning has been the focus of study by numerous researchers from marketing. These studies have included work from the area of new product development (McKee, 1992), strategic marketing (Frankwick, Ward, Hutt & Reingen, 1994), marketing management (Baker & Sinkula, 1999), market orientation (Slater & Narver, 1995) and marketing channels (i.e., Lukas, Hult & Ferrell, 1996). Bell, Whitwell and Lukas (2002) provide a review of the schools of thought in organizational learning, particularly focusing on those from the

marketing discipline. Much of the interest in this research stream stems from trying to understand how organizational learning can parlay into organizational competitive advantage. Bell, Whitwell and Lukas (2002) suggest that, organizational learning is critical to the process of developing market knowledge and, as such, operates as a driving force in, and governance of, market-oriented firms. Therefore, one component of organizational learning, market learning, involves learning about potential and actual markets and is, therefore, considered to be an important capability with respect to envisioning how products based on radical technologies will be delivered in the marketplace.

2.1.7 Market Learning

Lynn (1997) states that organizational learning is nowhere more critical than in a company's new product development efforts and such learning is specifically known as market learning. As such, one of the most important areas of research in New Product Development is the assessment of when and how consumers should be involved in the NPD process. One principle, which has been shown to influence customer involvement in the NPD process, is level of innovativeness. According to Colarelli O'Connor (1998) the "technology voice" tends to be louder at the beginning of a technology life cycle, whereas the "customer voice" tends to be louder later on in the technology life cycle. These processes are sometimes also referred to as "technology push" and "market pull".

One study that illustrates this proposition was published by Langrish, Gibbons, Evans and Jevons (1972) in "Wealth from Knowledge". This group undertook detailed case studies of 84 innovations that received the Queen's Award for technological innovation in 1966 and 1967, all of which were commercially successful. Of 84, eleven (13.2%) were termed "major" innovations (i.e., radical innovations). For major innovations, the "recognition of a discovery's usefulness" (push) (14.4%) was more important than demand-pull through need identification (6.1%). This finding was reversed for what they called "minor" innovations (i.e., incremental innovations), where need

identification was responsible for 18.3% of the innovations and the discovery factor was responsible for only 5%.

Given what has already been shown to be the relationship between technology life cycles and radical innovation—that radical innovations tend to occur early on in a technology life cycle—this means that technology push processes tend to be more prevalent with radical innovations. As such, while still desirable, it is more difficult to bring the voice of the customer into play for future markets, or for extant markets which are not yet familiar with a new technology early on in a given technology's life cycle.

Envisioning and understanding future markets is clearly an important component of Market Visioning Competence, so an important question involves whether, and if so how, it may be possible to incorporate the voice of the customer in the development of radical technologies into products for those markets. As such, the next section deals with the importance of the voice of the customer as has been demonstrated in the case of incremental innovation, and describes the challenges of hearing the voice of the customer in the technology push scenarios which tend to be more prevalent in the case of radical innovation. Some suggestions are made, based on the literature, as to how to listen to the voice of the customer for future markets with radical innovations and thereby how to improve Market Visioning Competence.

2.1.7.1 Challenges of Incorporating the Voice of the Customer: The Case of Radical Innovation. Consumer involvement is undeniably important to NPD in the case of incremental or continuous innovations, because the most consistent findings in success/failure studies has been that *unique product/service advantage in the eyes of the consumer* (Balachandra & Friar, 1997; Cooper, 1979; Cooper, 1981; Cooper, 1985; Cooper & de Brentani, 1984; de Brentani, 1989; 1991; de Brentani & Dröge, 1988; Lilien & Yoon, 1989; Mahajan & Wind 1992; Maidique & Zirger, 1984; Rubenstein, Chakrabati, O'Keefe, Souder & Young, 1976) and *product/service fit with market needs* (Booz, Allen

& Hamilton, 1982; Cooper, 1981; Cooper, 1985; de Brentani 1989; Sowrey, 1989) are significantly correlated with success. As Biolos (1996) puts it: customers should be involved early and often.

Early studies of innovation lead many scholars to conclude that the governing influence upon the innovation process is that of market demand and that recognition of demand is a more frequent factor in innovation than recognition of technical potential (Carter & Williams, 1969; Myers & Marquis, 1969; Rothwell, 1977). Although these findings are important to our understanding of the general level of contribution of technically-derived versus market-derived innovation in the economy, they may be misleading. Mowery and Rosenberg (1979) contend that the role of demand has been overextended and misrepresented, with serious possible consequences for our understanding of the innovation process and of appropriate government policy alternatives to foster innovation. First, innovation is not a simple linear process; the sources of innovation are multiple. Second, findings by Myers and Marquis (1969), imply that the situation is an "either/or" situation rather than indicating that there often are linkages between the two processes of "technology push" and "market pull". Third, the process of technological innovation often occurs on a grander scale, is sometimes related to more than one product platform or application, and the marketing world can take it down an infinite variety of paths during the course of the technological trajectory, sometimes even after technological innovation for all intents and purposes has ended.

In the case of radical innovation (occurring mostly during the early stages of a technological trajectory), markets that do not exist cannot be analyzed using the conventional marketing tools of incremental growth for opportunity identification, idea sourcing, and idea generation (de Brentani 2001; Lynn, 1993; Song & Montoya-Weiss, 1998; Veryzer, 1998). Customer needs, which usually form the basis for market targeting and segmentation, are often unarticulated or unknown by the customers themselves under higher levels of discontinuity (Moriarty & Kosnik, 1990). Not only are potential market

applications for disruptive technologies unknown at the time of a disruptive technology's development, they are usually unknowable. As well, under conditions of high technological uncertainty, potential manufacturers may not yet have rallied around a dominant design (Abernathy & Utterback, 1978). Also, individuals within firms may still be playing with prototypes, often under conditions of limited resources and partial information from the environment. The implication is that much of the way that companies currently manage market learning is irrelevant in the case of disruptive technologies. Applying inappropriate marketing, financial and management processes to disruptive technologies renders good companies incapable of creating new markets in which disruptive technologies are first used. As such, working to improve proficiency in business and market opportunity analysis may actually be counterproductive for discontinuous innovation (de Brentani, 2001; Song & Montoya-Weiss, 1998; Veryzer, 1998).

Related to these ideas, Christensen (1997) suggests that the decision-making and resource-allocation processes that are key to the success of established companies are the same processes that lead firms to reject disruptive technologies that they should be embracing; and, chief among these is 'listening carefully to customers' (p. 98). As such, Christensen warns us not to listen too closely to customers. This having been said, perhaps it is not about not listening to customers. It may be more about listening with the right potential customers and understanding that they are potential partners in developing new markets, as suggested by von Hippel (1988). With industrial markets, suppliers and customers tend to discover new markets together, thereby utilizing more of a 'customer active paradigm' approach or 'CAP' (von Hippel, 1988). With consumer markets, Narver, Slater and MacLachlan (2000, p. 8) state that the need to understand and satisfy customers' latent needs is critical—suggesting a 'manufacturer active paradigm' or 'MAP' (von Hippel, 1988). In the detailed description of Market Visioning Competence, which is provided at the end of this chapter, techniques are described which enable market pull (or the customer voice) to be brought into the realm of radical innovation to aid market

learning. This may be accomplished through the use of a Proactive Market Orientation—that is, the attempt to understand and satisfy customers' latent needs—in MAP situations and through the use of a variety of Market Learning Tools in CAP situations.

In sum, most marketers have been schooled extensively in the "art of listening to customers". Few, however, have theoretical or practical experience in how to discover new markets alongside potential customers either by attempting to discover latent needs together (Proactive Market Orientation) or by working with more than one market or scenario at the same time to push different potential futures forward and see how they unfold (Market Learning Tools).

2.2 Conceptual Foundations: Strategy and Vision

The examination of the economics, management and marketing literatures has made it possible to build a broad level of understanding regarding how radical innovation plays between firms and their environments, facilitated largely by individuals. This base provides the structure for developing the more specific conceptual foundations of this dissertation—that is, the constructs of interest: Market Vision and Market Visioning Competence. A detailed literature review covering these topics is provided in the sections that follow.

Market Vision, because it involves foresight with respect to a market of the future, is related to market strategy. Understanding how strategy operates in a firm, therefore, helps to build a better understanding of how vision operates in a firm. The nature of this relationship is described below. The term strategy, as it applies to businesses, has been defined in a number of ways, including:

- An organizational plan of action intended to move an organization toward its goals to achieve its mission (Harrison & St. John, 1994).
- An integrated and coordinated set of actions taken to exploit core competencies and gain a competitive advantage (Hitt, Ireland & Hoskinson, 1995).

- The moves and approaches devised by management to produce successful organizational performance (Thompson & Strickland, 1993).

The three components of strategy, which each of these definitions share, are an *action* component, a *planning* component and a *goal(s),* or *objective(s),* component. The degree to which each of these components (action, planning and goals) plays a role in any strategic context is related to level of innovativeness. In order for specific goals and plans to be drawn up, an organization needs to be aware that they are involved with an innovation. When an organization makes plans towards achieving specific goals (as per Harrison & St. John's 1994 definition), strategy is "intended" or "top down". As was noted in Chapter 1, in the case of radical innovations, however, the organization is often not aware of the informal bottom-up process of idea and information flow that is occurring and, in such cases strategy is much more "emergent".

Intended Strategy, therefore, is usually a top-down process where goals and objectives are a starting point from which business plans and actions can be developed and initiated (Mintzberg, 1979). On the other hand, *Emergent Strategy* is more of an unplanned, bottom-up process, often arising from autonomous actions of individuals deep within an organization and often not in conjunction with the firm's stated strategy (Burgelman, 1994; Mintzberg, 1979; Mintzberg, Pascale, Goold & Rumelt, 1996). As such, while actions certainly occur in the case of emergent strategy, any planning and/or goal setting is initiated by one or a few individuals close to the technology (Burgelman & Sayles, 1986; Crossan *et al.,* 1999).

According to Ettlie (2000), strategy in most companies is ordered in a hierarchy, with *corporate strategy* at the top ("What business are we in?"), followed by *business strategy* ("How should we compete in the businesses we are in?") and finally, *functional strategies* (e.g., marketing strategies, production and operations strategies, financial strategies). Each of these is discussed below.

Corporate strategy is defined by Andrews (1971, p. 18) as follows:

> Corporate strategy is the pattern of decisions in a company that determines and reveals its objectives, purposes or goals, produces the principal policies and plans for achieving those goals and defines the range of business the company is to pursue, the kind of economic and human organization it is or intends to be and the nature of the economic and non-economic contribution it intends to make to its shareholders, employees, customers and communities.

Based on this, the main issues involved with corporate strategy include the purpose and scope of the organization, which may involve consideration of diversification, internationalization, alliances and acquisition, but also, how the organization is to be run in structural or financial terms and how resources should be allocated to individual strategic business units or SBU's (Johnson & Scholes, 1997).

The second level in the strategy hierarchy may be thought of in terms of competitive or business unit strategy. Business strategy should be dictated by corporate strategy in that the decisions regarding how SBU's will compete should speak to the overall purpose and scope of the organization (Johnson & Scholes, 1997). *Business strategy* refers to how companies should compete in the businesses they are in. Major concerns at this level usually include how advantage can be achieved over competitors. For example, Porter's business strategies (1980) of product differentiation, cost leadership, and focus demonstrate three key ways that new opportunities can be identified and created for the business unit.

The third level of strategy, *project strategy*, occurs at the functional end of the organization. Marketing strategies, production and operations strategies, and financial strategies deal with how resources, processes, people and their skills are pulled together to achieve various projects. The various third level project strategies combine in an

architecture, which effectively delivers the overall direction of the business and corporation strategies together (Johnson & Scholes, 1997).

Vision is linked to strategy as the representation of future goals in people's minds (Stokes, 1991). Just as there are corporate (or organizational) strategies, business strategies, project strategies, marketing strategies, and the like, there are corporate (or organizational) visions, business visions, project visions, market visions, etc., which embody the goal component for each particular strategic level. As we move down the strategic, and vision, hierarchy from organization to business to project to marketing, strategy becomes more detailed and specific. In order to achieve the higher level strategies and goals, the lower level elements must first be achieved and incorporated together. All of the functional strategies, together, are required to achieve a project level strategy; project strategies combine to deliver business level strategies and all of the business level strategies are required to achieve the corporate level strategies. So too, with vision, the lower level goals are required to achieve the higher level goals.

For example, the "Organizational Vision", or corporate goal component, that is related to a corporate strategy may be to be in the business of optical switching. How the company plans for and then carries out the plans at the corporate level (for example, whether to diversify in-house or set up an alliance) are the plan and action components of corporate strategy. The "Business Vision" of business strategy for the same example might be to ensure that their company is always the customer's first choice for optical switches because it offers the highest quality products. How the company plans for and achieves this goal or vision at the business level (for example, through the delivery of a high level of product quality or through a reduction in cost) are the planning and action components of business strategy. The "Project Vision" and project delivery linked to the project strategy level in this top-down case would be facilitated by building incrementally on technical competencies within the firm, or possibly, by attaining them through a strategic alliance with another firm (depending on the corporate strategy). The vision of how all of the functional strategies must be pulled

together to achieve the business and corporate strategies is the Project Vision. The Market Vision that is linked to the market strategy level for the same example might be focused on the effective delivery and interfacing of the optical switching product and service to, for example, telecommunications companies in Canada.

In the above example, the "hierarchical" or "top-down" approach supports our understanding of how strategy and vision are linked and how each level is related in the case of incremental or continuous innovations, by moving from the general case to the increasingly specific case (i.e., from organizational strategy/vision to business strategy/vision to project strategy/vision and functional strategies and related visions).

In the case of radical innovations, however, the strategic approach is "emergent" or "bottom up", moving from the specific case to the more general case and lending understanding to a temporal sequence of progressively enhanced vision development. The chief difference between the emergent (bottom up) and hierarchical (top down) approaches to strategy lies in the directionality differences between problem identification and information search. While incremental innovation reinforces the core competencies and established capabilities of organizations, radical innovation forces companies to draw on new technical and commercial skills, and to employ new problem-solving approaches (Burns & Stalker, 1961; Ettlie, Bridges & O'Keefe, 1984; Hage, 1980; Tushman & Anderson, 1986). Idea/information flow in the radical case begins with the recognition of a technical discontinuity by individuals operating at the technical level. Ideas and information move upwards in the organization via small-groups working informally or through some formal acknowledgement regarding the development of the technology. Then it moves to the project-level for implementation (Colarelli O'Connor & Veryzer, 2001) once a project receives formal approval (Crossan, Lane & White, 1999). Project formalization leads to a flow of ideas to the organizational level across teams working for different projects, departments and strategic business units (SBU's). Burgelman and Sayles (1986, p. 31) coined this process "up from below".

If we go back to our previous example, the emergent strategic process in the radical innovation case results from a technology discontinuity rather than from ongoing corporate strategy. Thus, the initial vision development in the radical case is a "Technology Vision", resulting from technology discontinuity, and this Technology Vision resides only in the minds of one or a couple of individuals (Colarelli O'Connor & Veryzer, 2001). This Technology Vision, in our example, might possibly be to utilize a new biochemical enhancement technology to create high performing optical switches (new to these individuals, new to the company and new to the marketplace). Movement to another broader vision level occurs once a product-market insight has been reached utilizing the technology from the Technology Vision, through Market Visioning Competence (Colarelli O'Connor & Veryzer, 2001). This insight is Market Vision. Therefore, the Market Vision that is linked to the market strategy level for the same example might be to be the first company to make optical switches using the new biochemical enhancement technology (the technology vision) for international telecommunications companies which have the resources available to create the necessary interfacing required for such switching devices. In other words, Market Vision provides the techno-market insight or the mental image that organizational members have of a desired future market for a new technology. How the company goes about creating a market plan to carry this out is the planning component of market strategy. Once project formalization occurs, the Market Vision becomes a Project Vision. Lastly, the extant Organizational Vision may be updated in light of this emergent set of strategies and visions. Figure 3 describes these relationships, utilizing the emergent sequence as a framework.

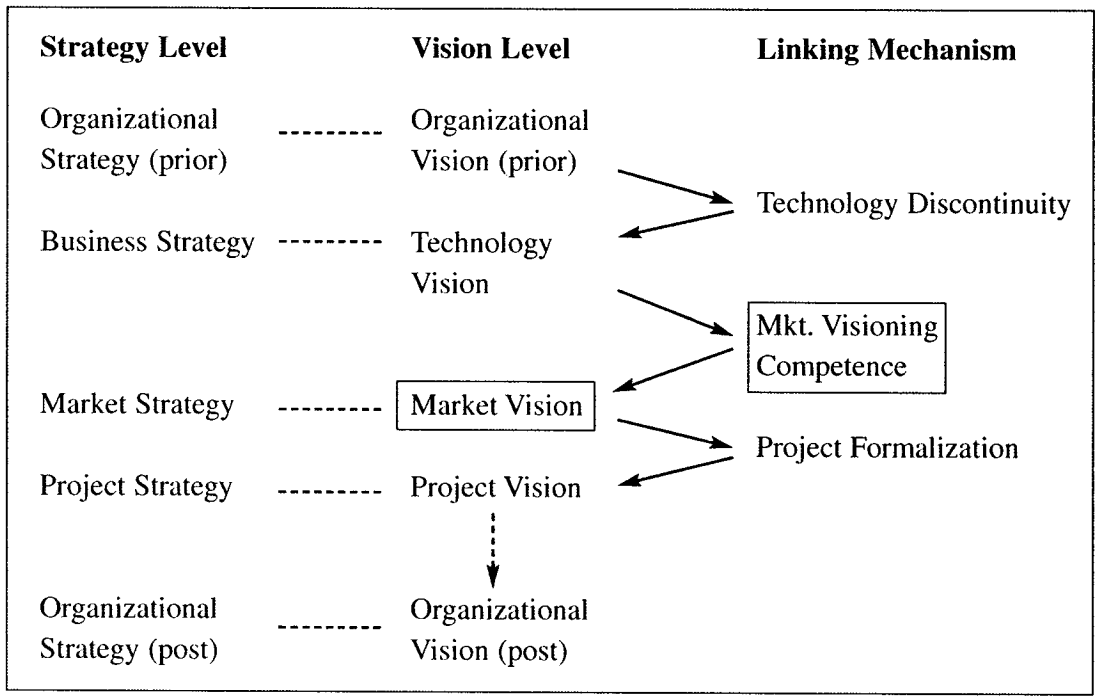

Figure 3. Sequence of Emergent Strategies and Visions (Radical Innovation)

2.3 Conceptual Foundations: Vision and Market Vision

The emergent approach to the strategic process described above and shown in Figure 3 offers the best overall framework for understanding how visions emerge and change in the radical innovation scenario. While visions become more elaborated, supported and shared as more people become involved at the project (Lynn & Akgün, 2001) and the corporate level (Collins & Porras, 1995), there are some components of vision which are shared, regardless of level. These shared components of vision can be thought of as "generic vision" and previous scholarship in the area of vision has focused largely on these shared components. Generic vision relates to all types of vision and therefore overarches our understanding of vision, regardless of type. As such, the following discussion first examines those aspects of vision which are embodied in all types of visions, providing a basis for understanding key aspects of Market Vision as well. Following this discussion of generic vision, the literature that deals with specific types of vision—that is, organization and project vision—is

investigated in order to provide further theory support where there is some potential relationship to Market Vision. Next, the domain of Market Vision is developed, based on literature considered to be relevant to building an understanding of this new construct. The domain of Market Visioning Competence is handled in a similar way.

2.3.1 What is Vision: A Generic View

Vision implies knowledge, insight and foresight, as well as an image of a desired future state (Christensen, 1997; Cummings & Davies, 1994; Jolly, 1997; Rice, O'Connor, Peters & Morone, 1998). Stokes provides a further description (1991, p. 118):

> A vision is an image of a desired future. It is a description of what a desired state should look like. It does not have to be grandiose or lengthy. And, while a vision may contain broad goal statements, it should not contain action steps to achieve the desired future state. Action steps come later. A vision is a description of 'conditions as we would like them to be' and is a prerequisite for the successful introduction of change.

These generic descriptions of vision denote three aspects of vision which are shared across different levels. First, as noted above in the strategy discussion, vision is related to the goal, but not the action steps, that a strategy must outline in order to proceed to a goal. Crawford and Di Benedetto (2000), who use the PIC to describe vision in terms of team directions, goals and objectives, support this understanding of generic vision. A second shared component mentioned in these definitions is that these goals are represented through an image or description. The descriptors of the vision itself—i.e., conditions as we would like them to be (i.e., desirability), how grandiose it is, and the specific conditions of the image—are *intrinsic dimensions* of the vision. These descriptors are considered intrinsic because they cannot be completely divorced from the mental

image or vision, itself. In other words, in some way they are related specifically to what the vision is or looks like. Images and descriptions are incorporated into knowledge systems within the organization, whether just for a few individuals or for the organization as a whole. Third, if vision is "foresight", then clearly there is uncertainty regarding what is described in the vision. The uncertainty regarding the description, leads to the conclusion that clarity with respect to vision must be an extrinsic component of vision. Uncertainty about an image—whether related to clarity, support or stability—suggests that an image itself is separate from thinking directed toward that image. In other words, one sees that image differently over time. As such, these three dimensions—clarity support and stability—are separate from the image itself and, therefore, are considered *extrinsic dimensions*. This way of understanding dimensions of vision—intrinsic versus extrinsic—is developed in this thesis to help better understand Market Vision.

According to Stokes (1991) (see above quote), a vision does not need to be grandiose. This view, however, has been challenged by several authors, particularly those who describe "vision" from the perspectives of the sociology and material culture literatures. For example, in his discussion of the building of the Brooklyn Bridge, Alan Trachtenberg (1964) describes the remarks of General Jeremiah Johnson, that "the magnitude of the undertaking gave it a visionary aspect" (p. 3). Further, Stokes' use of the word 'grandiose' seems to be broader in its meaning than just magnitude; it also seems to imply a certain range of possibilities. In other words, grandiose implies both magnitude and range of possibilities, which together imply scope. This disparity between authors points to two questions regarding vision. First, is scope an important component of vision? Second, is a certain scope required for successful vision? These questions are important, as the vision literature from previous research (generic, organizational, and project) has never investigated scope as a potentially important component of vision. As such, this dissertation examines whether or not scope is an important component of Market Vision.

In the following sections, previous research in the areas of Organizational Vision and Project Vision is described. First, the qualitative research of Collins and Porras (1995) on Organizational Vision provides us with a starting place for thinking about the *intrinsic* components of vision, as they apply to the organizational level. Second, the qualitative research of Hamel and Prahalad (1994), also at the Organizational Vision level, and the empirical work of Lynn and Akgün (2001), at the Project Vision level, are examined to further our understanding of the *extrinsic* factors of vision—that is vision clarity, vision support and vision stability. This research is presented and discussed in light of its potential relationship to the intrinsic and extrinsic components of Market Vision.

2.3.2 Organizational Vision

Because vision at the organizational level is very broad, often communicated externally to the media (through case histories and the popular press), and is often initiated from the corporate level with regard to incremental innovations, it has provided perhaps the easiest level of analysis for understanding vision from the outsider's perspective. As such, a good place to start trying to understand vision with businesses is at the organizational level with the concept of Organizational Vision.

Song and Montoya-Weiss (1998) in their study of 169 projects (radical versus incremental) determined that strategic planning at the organizational level, which they related to vision, was positively associated with new product success in the radical case. Given the directionality suggested for radical innovations, where Organizational Vision tends to be the last type of vision in the spectrum to be updated (as per Figure 3), the elements of strategic planning are likely related to putting the capabilities and processes in place that will enable effective visioning and vision to unfold throughout the spectrum suggested in Figure 3. As Collins and Porras (1995, p. 80 - 81) suggest, Organizational Vision is not about predicting the future; rather, it is about constructing the future:

> Having a great idea or being a charismatic visionary leader is 'time telling'; building a company that can prosper far beyond the presence of any single leader and through multiple product life cycles is 'clock building'. The builders of visionary companies tend to be clock builders, not time tellers...instead of concentrating on acquiring the individual personality traits of visionary leadership, they take an architectural approach and concentrate on building the organizational traits of visionary companies.

The notion of building a visionary organization is one that resonates with the approach that will be taken with this dissertation. In other words, an effective vision should be able to provide a structured focus around which plans and actions can move things successfully forward toward a goal. As suggested by Collins and Porras (1995), in order to build effective visions, processes and capabilities need to be developed that enable vision building. For example, Alcoa, the largest aluminum company in the world during the late 1980's, found itself at a juncture where people in the organization were not sure what the purpose of the organization was. At that time, a task force was coordinated and Alcoa decided that the vision of the organization would be a total quality orientation. Only through getting people from all levels of the organization involved in the task force and building a consensus at the organizational level, was the vision able to have a strong impact on the firm's performance. Prior to the development of the task force, Alcoa's dream of total quality management was just all talk (Kolesar, 1993).

2.3.2.1 Organizational Vision: Intrinsic Components. The work of Collins and Porras (1991; 1995) has importantly contributed to our understanding of the intrinsic components of Organizational Vision. At the organizational level, Collins and Porras (1991) describe vision as encompassing a *guiding philosophy*—comprised of *core beliefs*, *values* and *purpose*—which, given a certain environment, will lead to a *tangible image*. In describing

elements of this *guiding philosophy*, Collins and Porras quote 3M's Paul Carleton about the company's *core beliefs* and *values* (p. 37): "the 11th commandment: Thou shalt not kill a new product idea...Many great product ideas come from stumbling, but you can only stumble if you're moving." Such core beliefs and values can be related to people, customers, products, management, or business. In addition, *purpose* is part of a guiding philosophy, which should, according to Collins and Porras, be able to grab the "soul" of each organizational member. They quote Merck's 1989 "Statement of Corporate Purpose": "We are in the business of preserving and improving human life. All of our actions must be measured by our success in achieving this." (p. 38). The other key component of Organizational Vision, *tangible image*, is made up of the *mission or goal* of the organization as well as *a vivid description* of the goal. According to Collins and Porras the *mission or goal* clearly focuses the efforts of the organization, while a *vivid description* helps make the mission more alive. They use the term "big, hairy, audacious goal" when describing Organizational Vision—for example, when Kennedy in 1961 stated that NASA would land a man on the moon and safely return him to earth before the end of the decade. In other words, *vivid description* represents a vibrant, engaging and specific explanation of what it will be like when the mission is achieved. It provokes emotion and generates excitement. It transforms the mission from words into pictures, which is particularly important when a mission is not quantifiable. They go on to provide an excellent example of the mission, and its vivid description, by Henry Ford (p. 47):

> I will build a motor car for the great multitude...It will be so low in price that no man making a good salary will be unable to own one – and enjoy with his family the blessing of hours of pleasure in God's great open spaces...When I'm through everybody will be able to afford one, and everyone will have one. The horse will have disappeared from our highways, the automobile will be taken for granted...(and we will) give a large number of men employment at good wages.

In summary, the intrinsic components of Organizational Vision specifically stated by Collins and Porras (1991; 1995) are: 1) a guiding philosophy (made up of core beliefs/values and purpose) and 2) a tangible image (made up of the goal of the organization and the description of that goal). They also indirectly support the idea that scope (i.e., magnitude and range) is a third intrinsic component of Organizational Vision (in their Ford example: "a car for the great multitude").

2.3.2.2 Organizational Vision: Extrinsic Components. While Collins and Porras (1991; 1995) provide us with a description of the intrinsic components of Organizational Vision, there is another important set of factors—the extrinsic components—which they hardly touch on. The extrinsic side of vision was brought forward in Hamel and Prahalad's (1994) bestseller, "Competing for the Future", in which they examine vision through the case studies of several well-known companies and their products. Hamel and Prahalad were the first to assert that an effective Organizational Vision has three components: it must be *clear*, *supported* by others in the organization, and *stable*. This research clearly touched a nerve in the executive world as shortly following its publication, several CEOs published short op-ed articles in non peer-reviewed executive journals (i.e., including Giordan (1995), McAlister (1998) and Vaughan (1997)) describing the importance of clarity and support with regard to organizational vision, from their own experience. While this literature clearly points to an understanding of these extrinsic components of Organizational Vision—*clarity, support,* and *stability*—they are not clearly defined or elaborated in the way that they have been in the Project Vision literature. As such, the next section which describes Project Vision provides a more in-depth understanding of these extrinsic vision components at the project level.

2.3.3 Project Vision

In comparison with Organization Vision which is quite broad, Project Vision is quite specific. In the radical innovation scenario, as outlined in Figure 3, Project Vision occurs

only after a Market Vision has been formalized and prior to the potential updating of an ongoing corporate vision. Because, a specific Market Vision has been elaborated, formalized and accepted for further development, Project Vision tends to be quite specific. In other words, it usually is *clear* and *stable* and, because it has been accepted for further development, Project Vision typically has *support*—i.e., the three extrinsic components of vision as highlighted by Hamel and Prahalad (1994).

In discussing the Project Vision for the IBM PC, Lynn and Akgün (2001, pp. 376 - 377) note the following: "The vision, or blueprint, was a plan of when the PC should be launched, what features and benefits it should provide, who the target market would be, and where it would be sold." What is notable about this example of Project Vision is that it provides a broad plan or strategy for a new technology entering a new market. In the previous discussion, it was noted that visions should not include strategy steps or activities and this high level of specificity may be what makes Project Vision different from other types of vision (i.e., organizational, business, market). Project Vision, as perceived by project teams, is indirectly suggested by Brown and Eisenhardt (1995) as being a connection point between vision and the action steps of project strategy. They describe vision from the perspective of new product teams and define it as the meshing of an organization's competencies and strategies with the needs of the market to create an effective product concept. In other words, once the product concept has become clear enough to include more detailed aspects of project strategy (such as the answers to some *how*, *when* and *where* questions), then it has moved through the spectrum shown in Figure 3 from being a Market Vision to a Project Vision (Brown & Eisenhardt, 1995; Lynn & Akgün, 2001). Project Vision, therefore, provides the necessary action steps to form the link between the specific product and the market. This is different from Market Vision, which enables the image of *what* the product-market interface looks like, but does not involve action steps (*how, when, where*).

2.3.3.1 Project Vision: Extrinsic Components. In this section, past empirical research on Project Vision is described. As discussed below, in the case of Project Vision, only the extrinsic factors have been studied empirically.

Through the empirical research of Lynn & Akgün (2001) at the project level, scales and definitions were developed for Hamel and Prahalad's (1994) three extrinsic components of vision—that is—Project Vision Clarity, Support and Stability. According to Lynn & Akgün (p. 375), Project Vision Clarity refers to "having a well-articulated, easy-to-understand target: a very specific goal that provides direction to others in the organization". Project Vision Support (also referred to as "shared vision") "implies securing the commitment from people throughout an organization for what the company is trying to do. It indicates that people are willing to pitch in to help accomplish the vision—to do whatever it takes to achieve their goal". Project Vision Stability is seen as "the ability for a vision to remain consistent over time". These three components of vision are considered to be the extrinsic components of both Organizational and Project Vision.

The results of the Lynn and Akgün (2001) study show that the best model fit, in terms of the number of underlying dimensions, was found for Project Vision with a three-dimensional structure including Project Vision Clarity, Project Vision Support and Project Vision Stability. Their quantitative analysis demonstrated further that, for radical innovations, Project Vision Clarity was significantly associated with new product success while Project Vision Stability was not. In the case of Project Vision Support, the link to new product success depended on where the support was coming from. These findings are consistent with the work of Rice *et al.* (1998), who demonstrate that, for successful radical innovations, teams should have Project Vision Clarity but flexible project plans (i.e., not necessarily Project Vision Stability). Lynn and Akgün's finding vis-à-vis vision Project Vision Support, however, is contradictory to studies on vision with radical innovation performed by Colarelli O'Connor and Veryzer (2001), who found that Project Vision Support did impact performance in the case of radical innovations. Lynn and Akgün

suggest that this may be related to a difference between support by team members (as per Colarelli O'Connor & Veryzer, 2001) versus support by team managers (as per Lynn & Akgün, 2001). The Lynn and Akgün study found that support by team managers is significantly associated with new product success, whereas support by team members and by top management is not. Rice *et al.* (1998) studied 11 cases of radical projects and found that first-line managers or team managers (not senior managers) are the individuals who recognize the opportunities of radical projects. However, top management support has been shown by other authors to be important to success with radical innovation due to the high risk and uncertainty levels of such projects. Active involvement by senior managers as sponsors, visionaries and mentors is a primary distinguishing feature impacting performance in the discontinuous case (Colarelli O'Connor & Veryzer, 2001; Cooper, 1984; deBrentani, 2001; Maidique, 1980). These equivocal results, which could largely result from variance in testing methodologies, point to the need to investigate further the nature of Project Vision Support.

The finding vis-à-vis the lack of statistical support in the Lynn and Akgün (2001) study for the importance of Project Vision Stability at the project level was also somewhat surprising. For Project Vision Stability, particularly at the project level, having a specific or "nailed down" vision would seem to be an important component of a successful Project Vision. Without stability, it is difficult to see how any idea, radical or not, can move forward in the NPD process (Cooper, 1993; Crawford, 1980; Crawford & Di Benedetto, 2000). Lack of statistical support for Project Vision Stability may be an artifact of the methodology used in the Lynn and Akgün study (i.e. cross-sectional rather that longitudinal data). For example, the wording of the three items used (e.g., one item was: "the pre-prototype design goals remained stable through launch") indicated that it might be very difficult for any single person to comment effectively on such an issue, particularly if the development time horizon was long. As such, the previous empirical findings on project vision with radical innovations may not be indicative of the importance of Project Vision Stability.

One last point that should be noted here is that, based on Lynn and Akgün's (2001) conceptualization of Project Vision, it is difficult to distinguish between the two constructs, Organizational Vision and Project Vision. The factors Lynn and Akgün used to test Project Vision are the same as those suggested by Hamel and Prahalad (1994) to test the extrinsic components of Organizational Vision: Clarity, Support and Stability. This is particularly surprising given the definition for Project Vision that Lynn and Akgün provide. This definition includes "*when*", "*what*", "*who*" and "*where*" aspects, which are descriptors that provide information about the content of the vision. In other words, while their definition suggests intrinsic components of vision, they did not operationalize it in this way for testing. Therefore, while Lynn and Akgün utilized the extrinsic components of Organizational Vision, they did not use a set of intrinsic components to measure Project Vision, which seems to be an important omission.

2.3.4 Market Vision: Intrinsic Components

As detailed above, vision has been explored in the literature as it pertains to generic vision, Organizational Vision and Project Vision. The topic of this thesis, Market Vision, has not been investigated. This is interesting given that Market Vision is discussed as an important component of popular strategic management paradigms proposed by strategic thought leaders (e.g., Hamel & Prahalad, 1994). It is necessary, therefore, to build on the extant literature which has been described and bring these ideas forward in a way that would make sense when applied in the concept development of Market Vision.

The intrinsic components of generic vision were shown to be related to goals through an image or description. As discussed, the description of a vision may potentially include: the specific conditions of the image, how grandiose it is and how desired it is. These descriptors suggest that *form* (what the specific conditions of the image are), *scope* (the size and range of possible conditions), and *magnetism* (how compelling or desirable

the vision is) are intrinsic components that are shared across all visions. These intrinsic components are related to the concept of Market Vision in the discussion that follows.

2.3.4.1 Market Vision Form. Images and descriptions of vision are incorporated into knowledge systems within the organization, whether just for a few individuals or for the organization as a whole. Individuals create representations, or mental models, of external realities; they structure them into patterns, or models, which are stored in memory and later retrieved in order to process new sense data that is encountered (McCulloch & Pitts, 1943; Gardner, 1985). The organizational theory and learning literatures, while holding many views on how individuals and organizations may relate knowledge, are fairly clear on a few key aspects of this relationship (Stacey, 2001): first, there is one level of explanation called the individual mind and another called the organization, which is a social structure or institution. Second, knowledge creation in organizations is thought of as a system in which new knowledge arises in individual minds. Third, it is possible for humans to transmit mental contents to each other so that they can be shared as the basis of organization. Market Vision is considered, in this dissertation, to occur at the product-market level, largely among individuals who share a mental model of this product-market vision *form.*

Vision was defined previously in a generic sense: "Vision implies knowledge, insight and foresight, as well as an image of a desired future state" (Christensen, 1997; Cummings & Davies, 1994; Jolly, 1997; Rice *et al.,* 1998). From the organizational vision literature, the image described generically above, is most effective when tangible. Tangibility, which will be described later as an extrinsic component of vision, as explained by Collins and Porras (1991; 1995), is brought about through the *mission or goal* which provides clear focus, and a *vivid description* which helps make the mission more alive. If applied to Market Vision, a vivid description should be with respect to the market goal. Because "market", according to Kotler, Armstrong & Cunningham (1999, p. 13), is

defined as "the set of all actual and potential buyers of a product or service", a description of the potential or desired market, should therefore provide an important focal point, or goal, for the Market Vision. This description of the market goal is the Market Vision Form.

Market Vision Form includes the concepts of product design, product concept and product-in-use. *Product design* involves the idea of what the components of the product will be and how they will be integrated (Ulrich & Eppinger, 1995). Due to the situation with radical innovations whereby prototypes are typically developed earlier than in top-down situations, an important component of Market Vision for radical products is likely to include an early idea of product design (Shanklin & Ryans, 1984; Lynn, 1993). *Product concept* involves the relationship between anticipated product features and customer benefits. Anticipating product fit with market needs has been shown to be critical to success for any product (Booz, Allen & Hamilton, 1982; Cooper, 1979; Crawford, 1980). *Product-in-use* involves the idea of how the product and users will interact, and what the system of interaction will look like. An understanding of how a product might fit into an overall system of use with other products and in the environment has also been shown to be critical to success (Rogers, 1983; Sengupta, 1998; Tripsas, 2000).

2.3.4.2 Market Vision Scope. Market Vision Scope includes the ideas of target magnitude and target market. *Target magnitude* involves the scope or breadth of the envisioned market and is potentially an important component of vision because markets, which have good potential size, offer better outcomes (Cooper, 1981; 1985; Cooper & de Brentani, 1984). *Target market* involves the specific market of focus for the product to be developed (Crawford, 1980; Cooper, 1993). A target market is an important component of Market Vision Scope because it provides the focus for other vision components such as product-in-use and, therefore, determines the direction of the development path. The target business areas described by Crawford in his Product Innovation Charter (1980) (by product type, end-user activity, technology, intermediate- or end-user group) provide a

useful classification of target markets. Therefore, Market Vision Scope provides both a goal focus, similar to the way Market Vision Form does, and also provides a link to the potential for success.

2.3.4.3 Market Vision Magnetism. Market Vision Magnetism refers to how compelling, important or desirable the vision is in the eyes of members of the organization (McAlister, 1998). This concept, magnetism, operates in a manner similar to the way people are drawn to a charismatic leader. In the case of Market Vision, however, it involves the way in which people are drawn to an idea pertaining to a product-market interface. Importance and desirability of an idea are related to the notion of *guiding philosophy*, because people are attracted to ideas that they can relate to their own core beliefs, values and purpose (Collins & Porras, 1991; 1995). A vision with a magnetic quality acts to infuse value into the organization (Selznick, 1957), whether this value is externally recognized or not. This is related to the idea that, in order for organizations to move in a coordinated direction toward their vision of the product-market interface, they must inherently believe in and identify with that vision. Therefore, the power to motivate individuals to strive for and attain a given goal has inherent "value' for the organization and for the market (Selznick, 1957, p.19), because "organizations become infused with value as they come to symbolize the community's aspirations".

2.3.4.4 Market Vision Discontinuity. Another potential intrinsic dimension of Market Vision concerns the level of discontinuity of the vision. Market Vision Discontinuity, based on the definition of discontinuous innovations presented at the beginning of the literature review, would involve the level of newness of a vision compared to visions that have already been enacted or are known in the marketplace for the same technology, or for a technology that can be substituted for with the new technology. Highly discontinuous visions would be related to slower diffusion (Gatignon & Robertson, 1986) because of

high levels of complexity, risk and uncertainty, coupled with low levels of trialability (Rogers, 1983). Market Vision Discontinuity has not been specifically highlighted in the generic vision literature; however, it may be potentially related to the goal component of vision because higher levels of discontinuity have been related to higher levels of success (Kleinschmidt & Cooper, 1991). Although higher levels of discontinuity require greater efforts to obtain solutions, they are capable of delivering greater benefits to users in the forms of needed products and processes (Schmookler, 1966; Cooper, 1981; 1985; Cooper & de Brentani, 1984; Garcia & Calantone, 2002). This relationship between discontinuity and new product success is further linked to the situation that visions that are highly discontinuous offer a path to rare, valuable and inimitable capabilities, which offer the potential to capture competitive advantage (Barney, 1991). Therefore, providing higher levels of discontinuity in new product development is often a goal of firms involved with developing advanced technologies. As with radically new or truly discontinuous products, a high level of Market Vision Discontinuity involves the development of new market infrastructure and new technology infrastructure both inside and outside the firm (Garcia & Calantone, 2002). This concept is related to the notion of substitution—that is, how easy it is for the new vision to be enacted, given the current state of infrastructure, or what is required for a new infrastructure to be put into place. While high levels of discontinuity and substitution are difficult to achieve both economically and socially, discontinuous visions that are truly important and desirable in the eyes of potential consumers still have a good chance of being enacted in the marketplace.

2.3.5 Market Vision: Extrinsic Components

The three extrinsic components of vision which have been highlighted in the contexts of Organizational and Project Vision are also relevant in the case of Market Vision. Thus, how vision clarity, support and stability relate to the technology-market interface is described below.

2.3.5.1 Market Vision Clarity. Vision clarity refers to "having a well-articulated, easy-to-understand target—a very specific goal that provides direction to others in the organization" (Lynn & Akgün, 2001, p. 375). Ackoff (1970) and Drucker (1954) also emphasize the need for creative objectives to be made operationally meaningful and tangible. *Tangibilization* of image ultimately aids the extrinsic vision components of clarity and support. To ensure Market Vision Clarity, Market Vision needs to be tangibilized so that mental models of a product-market interface can hold a vivid image particularly of the market form and its scope. It is this tangible image of the product-market interface form and scope—that is, the target market and its magnitude—which allows Market Vision Clarity to occur. Therefore not only is vision clarity important at the organizational and project levels of analysis, it is also important in the case of Market Vision.

2.3.5.2 Market Vision Support. Vision support "implies securing the commitment from people throughout an organization for what the company is trying to do. It indicates that people are willing to pitch in to help accomplish the vision—to do whatever it takes to achieve their goal" (Lynn & Akgün, 2001, p. 375). In order to secure support, mental models must be shared between individuals and the organizational system, which could be a small group of individuals, a project team, or the entire corporation. Therefore, this underlying mechanism which allows market forms or mental models of the market to be shared back and forth between individuals is important to understanding how Market Vision Form and Market Vision Scope are shared. As we saw in the previous discussion, studies by Lynn and Akgün (2001), Rice *et al.*, (1998), and Brown and Eisenhardt (1995) indicate that teams (particularly team managers) are important to supporting a vision at the project level. Studies by Cooper (1984), Colarelli O'Connor and Veryzer (2001), de Brentani (2001), de Brentani and Kleinschmidt (2004), and Maidique (1980) show that senior management support as sponsors, visionaries and mentors is a primary distinguishing feature impacting organizational-level and project-level performance for

radical innovations. According to Kim and Wilemon (2002), senior management helps provide the resources necessary for the project team in the fuzzy front-end (FFE) and helps provide a clear vision of company objectives, which a new product will support. Given that new product ideas in the FFE are often uncertain and tend to be initiated in a "bottom-up" fashion, particularly for radical innovation, from a senior manager's perspective supporting these ideas is not as easy as supporting 'validated' ideas during the development phase of the NPD process. As such, support for Market Vision with radical innovation often means securing commitment from those individuals who are involved informally in developing the technology and in looking for product-market ideas for the technology, regardless of the formal position they occupy. Therefore, vision support ("shared vision") may also be an important component of Market Vision; however, the findings were equivocal (see discussion under Project Vision) and so are worthy of further investigation.

2.3.5.3 Market Vision Stability. Vision stability, the ability for a vision to remain consistent over time (Lynn & Akgün, 2001), has been suggested to be an important component of Organizational Vision (Prahalad & Hamel, 1994), but not to be related to success when tested at the project level for radical innovations (Lynn & Akgün, 2001; Rice *et al.*, 1998). According to Lynn and Akgün (2001), vision stability at the project level may not be critical for successful radical innovations because there are many paths for achieving the designed ends, which may be unknown or unknowable at project outset under highly uncertain conditions. As such, given that Market Vision is proposed to occur earlier than Project Vision, it is unlikely that a Market Vision will be stable or that vision stability is a critical phenomenon at this early stage.

2.3.6 Market Vision: Developing a Conceptual Framework

Based on the literature review, our understanding of Market Vision is enhanced by conceiving its underlying dimensions as being of two types. First, those dimensions

considered "intrinsic" are what the vision is or looks like. In other words, intrinsic dimensions capture the essence of vision itself. Second, those dimensions considered "extrinsic" are separate from the image and speak to some level of uncertainty which people hold about the vision.

In developing a framework for Market Vision, therefore, Market Vision Form, Market Vision Scope, Market Vision Magnetism, and Market Vision Discontinuity (the "intrinsic" dimensions), and Market Vision Clarity and Market Vision Support (the "extrinsic" dimensions) are proposed to comprise the key underlying concepts. These components of Market Vision, together with references from the relevant literatures, are detailed in Table 1. These ideas can be combined to produce a potential definition for Market Vision for radical new products. According to this dissertation,

> Market Vision is proposed to be a clear and specific mental image (or mental model) that organizational members have of a desired and important product-market for a new technology. This image includes potential users, a potential product concept and the potential interaction of user and product in the use environment and in the marketplace.

Table 1
A Framework for Market Vision

Components of Market Vision[1]	Underlying Concepts[2]	Supporting References
Intrinsic Dimensions:		
Vision Form	A vividly described or tangibilized goal is an important component of Market Vision form, in order to engender clarity and support (extrinsic factors).	Collins & Porras, 1995
	Product Design involves the idea of what the components of the product will be and how they will be integrated. Due to the situation with radical innovations whereby prototypes are developed earlier than in other top-down situations, an important component of Market Vision for radical products is an early idea of product design.	Shanklin & Ryans, 1984; Lynn, 1993; Ulrich & Eppinger, 1995
	Product Concept is a relationship between anticipated product features (form or technology) and consumer benefits (a claim of proposed satisfactions). Anticipating product fit with market needs has been shown to be critical to success for any product.	Booz, Allen & Hamilton, 1982; Crawford, 1980
	Product-in-use involves the idea of how the product and users will interact, and what the system of interaction will look like. An understanding of how a product might fit into an overall system of products has also been shown to be critical to success (complementary products).	Sengupta, 1995; Tripsas, 2000
Vision Scope	Target Magnitude involves the scope or breadth of the envisioned market and is an important component of vision because markets, which have good potential size, offer better outcomes.	Cooper, 1981; Cooper, 1985; Cooper & de Brentani, 1984

Continued on next page

[1] This framework builds on ideas provided by Collins and Porras (1995) and Lynn and Akgün (2001).
[2] These ideas are based on a broader reference search

Components of Market Vision	Underlying Concepts	Supporting References
Intrinsic Dimensions:		
Vision Scope	Target Market involves the market of focus for the product to be developed. A target market is an important component of vision form because it provides the focus for other vision components such as product-in-use, and therefore, determines the direction of the development path. The target business areas described by Crawford in his Product Innovation Charter (1980) (product type, end-user activity, technology, intermediate- or end-user group) provide a useful classification of target markets.	Crawford, 1980; Cooper, 1993
Vision Magnetism	Importance and desirability of an idea related to the product-market interface are related to guiding philosophy because people are attracted to ideas they can relate to their own beliefs, values and purpose.	Collins & Porras, 1995
	A Market Vision with a magnetic quality (importance, desirability) acts to infuse value into the organization and the market.	Selznick, 1957
Vision Discontinuity	Higher levels of innovation discontinuity are related to higher levels of innovation success.	Kleinschmidt & Cooper, 1991
	Higher levels of vision discontinuity represent low levels of substitutability due to new market infrastructure and new technology infrastructure required. However, visions that are highly discontinuous offer a path to rare, valuable and inimitable capabilities which offer the potential to capture competitive advantage.	Barney, 1991; Garcia & Calantone, 2002
	Higher levels of discontinuity, require greater efforts to obtain solutions, however are capable of delivering greater benefits to users in the forms of needed products and processes. Product's expected advantage was found to be one of the most important screening criteria used by managers.	Schmookler, 1966; Cooper, 1981; Cooper, 1985; Cooper & de Brentani, 1984
	Diffusion Rate describes how quickly a given technology is adopted by a firm, turned into new products and adopted by consumers. Highly discontinuous vision is related to slower diffusion because of high levels of complexity, risk and uncertainty coupled with low levels of trialability, observability, compatibility. These are good indicators for vision discontinuity.	Gatignon & Robertson, 1986; Rogers, 1983

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Components of Market Vision	Underlying Concepts	Supporting References
Extrinsic Dimensions:		
Vision Clarity	A very specific and clear product-market goal is able to provide direction to others in the organization.	Giordan, 1995; Hamel & Prahalad, 1994; Lynn & Akgün, 2001; Neimes, 1996; Rice et al., 1998; Vaughan, 1997
	Operationally meaningful and tangible Market Vision Form is necessary for clarity.	Ackoff, 1970; Drucker, 1954
Vision Support	Support from team managers is critical for moving forward a Market Vision.	Lynn & Akgün, 2001; Rice et al., 1998
	Support from top management is critical for moving forward a Market Vision.	Cooper, 1984; de Brentani, 2001; Giordan, 1995; Kim & Wilemon, 2002; Maidique, 1980; McAlister, 1998; Vaughan, 1997
	Support from team members is critical for moving forward a Market Vision.	Colarelli O'Connor & Veryzer, 2001; Ettlie, 2000; Burgelman & Sayles, 1986; Leonard-Barton, 1995

2.4 Conceptual Foundations: Market Visioning Competence

As described above, Market Vision is proposed to be a clear and specific mental image (or mental model) that organizational members have of a desired and important product-market for a new technology. Given the early timing of the development of Market Vision with respect to when the organization gets involved with an advanced technology, such a vision would serve to direct organizational members' awareness to a market end-state or goal, thereby allowing them to focus attention on those market application issues relevant for new products that stem from a given advanced technology (Hamel & Prahalad, 1994; Lynn & Akgün, 2001; Collins & Porras, 1995). But, how do companies develop a useful Market Vision? Based on the literature (described below), Market Visioning Competence is comprised of a set of organizational capabilities that enable the linking of advanced technologies to a given market opportunity of the future (Colarelli O'Connor & Veryzer,

2001, p. 231), and do so through a shared mental model of such a potential future product-market (the Market Vision, itself). Therefore, while Market Visioning Competence can be seen a set of capabilities within the firm linked to creating a Market Vision, Market Vision is the market-related mental model that results from these capabilities.

Although the set of capabilities which bridge between technological capability and market need is well understood for more conventional new product development (for example: Cooper, 1984; Crawford, 1997; Hughes & Chafin, 1996; Ulrich & Eppinger, 1995; Urban & Hauser, 1993), questions remain concerning how the link between advanced technologies and market need occurs for radical innovation. For example, there are still no clear cut answers for firms regarding how to pick one of several potential market applications for a new technology in development. New product development in this context usually involves greater uncertainty than is the case for the development of more incremental innovations and, while this means that there are more potential avenues for development, it also requires an effective 'visioning' capability to yield a successful outcome. This is because visioning can help answer the question regarding market applications, and does so through the delivery of a Market Vision. A review of the literature suggests that Market Visioning Competence involves individual capabilities (*Networking, Idea Driving)* and organizational capabilities (*Proactive Market Orientation* and *Market Learning Tools).* The seminal literatures contributing to our understanding of these concepts are described in the sections that follow.

2.4.1 Networking

Both Colarelli O'Connor and Veryzer (2001) and Lynn (1993) consider Networking to be a key element in creating and developing visioning competence These authors stress the importance of the webs of external relationships developed by individuals of the firm. These networks help to broaden thinking by giving individuals the opportunity to draw on new and different areas of knowledge and product application situations, rather than

focusing on current customers and markets. This process is called "vision migration" and also "divergent visioning" (Colarelli O'Connor & Veryzer, 2001; Lynn, 1993). When considering Market Visioning Competence, individuals' external networks may involve venture capitalists/bankers (OECD, 2000; Schumpeter, 1911; Zider, 1998), members of government (Fransman, 1999; Freeman, 1987; Lundvall, 1992), lead users and suppliers (von Hippel, 1986; 1988), as well as members of vertical alliance relationships (Baum, Calabrese & Silverman, 1999; Freeman, 1987; Håkansson & Laage-Hellman, 1984; Hagedoorn, 1993; Osborn & Hagedoorn, 1997). Due to the large number and variety of relationships that can be cultivated externally to a firm, instead of focusing on "who" is involved, it is more important to focus on "what" the structural features of the network are, and around which an advantage can be built (Granovetter, 1973; 1983). Therefore, in this dissertation, the decision was made to focus on the "what" because of the difficulties involved in creating a dimension that is based on the "who" aspect. As was described previously (see section 2.1.4), the aspects of breadth (or size), variety and centrality (Berkowitz, 1982; Granovetter, 1973; 1983; Scott, 1990) are the structural characteristics of a network, which exist regardless of who is part of the network and which provide competitive advantage. These are used as items by which to conceptualize Networking as it relates to Market Visioning Competence.

From the firm's perspective, the individuals involved in networks that are external to the firm are referred to as "boundary spanners". These boundary spanners have been described as persons who operate at the periphery or boundary of a permeable organization, performing organizationally relevant tasks, but relating the organization with elements outside it (Aiken & Hage, 1972; Leifer & Delbecq, 1978; Keller & Holland, 1974; 1975). These individuals are primarily responsible for the information exchange between the organization and its task environment, or boundary spanning activity. Therefore, when talking about networks, it is primarily the networks of boundary spanners which are being described in the context of Market Visioning Competence.

2.4.2 Idea Driving

Idea Driving is described by Colarelli O'Connor and Veryzer (2001) as comprising two components: first, individuals acting as idea drivers and second, activities devoted to gaining internal and external idea acceptance and validation. Individual idea drivers might include individuals called "ruminators", "champions" or "implementers" (Colarelli O'Connor & Veryzer, 2001). Inventors and ruminators are usually responsible for the emergence of new technology within the sphere of the organization because they occupy positions where they either work directly with the new technology, or are involved with markets where there is a possibility of an application for the technology (Allen, 1977; Roberts, 1977). Because such individuals are in a position to recognize and perceive new patterns and changes in the environment, they also usually have the ability to impact the movement of ideas to others in the firm. Indeed, much of the early information search in the case of discontinuous innovation may be driven by these key individuals, without involvement or knowledge of larger groups of people, particularly those operating at higher levels in the organization. As such, the role of the individual takes on a heightened importance (Burgelman & Sayles, 1986; Colarelli O'Connor & Rice, 2001; Colarelli O'Connor & Veryzer, 2001; Crossan *et al.*, 1999; Rogers & Shoemaker, 1971), particularly during the early stages of the fuzzy front-end of new product development, prior to project formalization, where Market Visioning Competence occurs.

According to Colarelli O'Connor and Veryzer (2001, p. 244), "individuals may play different roles in the visioning process". In some cases, singular individuals provide and implement a vision; in other situations, the initial vision is provided by one individual and carried out by others. This suggests that "complementary skills may be required from different individuals in order for the process to unfold" (p. 244). The literature (e.g., Howell & Higgins, 1990; Howell & Shea, 2001; Schon, 1963; 1967) supports the notion of the champion (or more than one champion) as the one(s) responsible for pushing ideas forward from the individual up through the organization for radical innovations. TIM authors, supporting the individual-level perspective, have focused on the study of champions of

innovation (e.g., Achilladelis *et al.*, 1971; Burgelman & Sayles, 1986; Chakrabati, 1974; Howell & Higgins, 1990; Howell & Shea, 2001; Schon, 1967). NPD studies, which have drawn from the Marketing and Management Sciences, have also focused on champions in both incremental (Cooper & Kleinschmidt, 1986; 1987; Gupta & Wilemon, 1996; Kim & Wilemon, 2002; Markham, 1998; Zirger & Maidique, 1990) and radical scenarios (Colarelli O'Connor & Veryzer, 2001; de Brentani, 1995; 2001; Leifer *et al.*, 2000; Maidique, 1980; Veryzer, 1998). A champion is generally seen as an individual who informally emerges in an organization and who makes a decisive contribution to an innovation by actively and enthusiastically promoting its progress through critical stages, particularly those early on in the NPD process (Achilladelis *et al.*, 1971; Burgelman & Sayles, 1986). As such, "champions" or "idea drivers", to use the terminology of Colarelli O'Connor and Veryzer (2001), provide important individual-level capabilities that are a part of Market Visioning Competence. In order to measure the level or strength of championing, Howell and Shea (2001) have provided a three factor, 16-item scale (alpha = 0.93) to measure champion behaviour. The most relevant factor in the case of Idea Driving is that which measures the ability to build involvement and support for a given idea (5 items).

Championing is closely related to the ideas of intrapreneurship (Rubenstein, 1994) and entrepreneurship (Schumpeter, 1911) as discussed previously. It is important for idea champions to know how to gain, even accelerate, the commitment and involvement of management for a proposed idea. This is critical because, as Frost and Egri (1991) point out, innovation at its core is a political and social process of change. As such, the 'politicking' described above as necessary during visioning is critical and likely directly related to driving the Market Vision Support aspect of Market Vision.

2.4.3 Proactive Market Orientation

Market learning, in the case of radical innovation, is a phenomenon that occurs both at the organizational level and also in the minds of individuals (such as the champions described

above), impacting both their behavior and cognition. According to Moorman and Miner (1998), a learning process is an "improvisation" if it is active (doing, not contemplating), novel, extemporaneous (impromptu) and deliberate (not simply an accident). While "behavioral improvisation" refers to merely new behavior on the part of individuals, "cognitive improvisation" provides whole new meaning to an issue. In the situation considered here, Market Visioning Competence relies largely on cognitive improvisation as a form of learning. This is most likely the case because involvement with a radically-new technology, by definition, is novel and requires active decisions on the part of individuals in the firm whether to pursue it (deliberate, active). Further, due to the bottom-up nature of learning in these situations, both the problem and decision are often unstructured (as described previously) and, therefore, extemporaneous and requires quite some effort in terms of moving from a fairly evolutionary mode of thinking to a much more radical mode. While learning about new markets occurs in the minds of individuals, the culture of the firm (Deshpande, Farley & Webster, 1993) and the overall enabling of information collection and dissemination (Narver & Slater, 1990; Kohli & Jaworski, 1990) are organizational capabilities which set the stage for market learning. The active and deliberate nature of market learning in radical scenarios is thereby enabled through Proactive Market Orientation, an organizational capability. As Day (1994, p. 9) stresses, learning is about more than just taking in information: "The learning process must include the ability of managers to ask the right questions at the right time, absorb the answers into their mental model of how the market behaves, share the new understanding with others in the management team, and then act decisively". Market learning is described by Colarelli O'Connor and Veryzer (2001, p. 232) as "the manner by which a direction and sense of the market opportunity are infused into the innovation process".

The nature of market learning processes in market-driven (or "market oriented") firms is proposed by Day (1994) to include: open-minded inquiry (data collection and scanning); wide-spread information distribution that assures that relevant facts are

available when needed (data distribution); mutually-informed mental models that guide interpretation and ensure that everyone pays attention to the essence and potential of the information (interpretation); and—to help these processes at the organizational level—an accessible memory of what has been learned. These processes, suggested by Day, can be largely facilitated for individuals through the use by the organization of a Decision Support System (DSS) (Song & Montoya-Weiss, 1998).

Day (1994, p. 9) supports the notion of the importance of a Proactive Market Orientation by stating that "market-driven firms stand out in their ability to continuously sense and act on events and trends in their markets." Further, Dutta, Narasimhan and Rajiv (1999) show that a strong market orientation is one of the most fertile sources of ideas for innovation. Therefore marketing, as much as possible, needs to be involved from the beginning of the innovation process when technological ideas are being generated. In particular, Dutta *et al.* found that firms with high installed technological bases, in combination with marketing capability, have the greatest levels of firm innovativeness. In other words, those firms that are already strong technologically have the most to gain through improved marketing capability (Dutta, Narahimhan & Rajiv, 1999).

The original research with market orientation, according to Narver and Slater (1990), consists of three behavioral components: customer orientation, competitor orientation and inter-functional coordination. Further work by Deshpande and Farley (1998) analyzed these three widely used behavioral measures of market orientation and developed a synthesis measure of market orientation. Because this measure is focused on customers' expressed needs, it is considered to represent "reactive market orientation" in that the manufacturer is responding or reacting to the requests of customers. In response to the criticism that there are penalties to firms that listen too closely to their customers (Christensen & Bower, 1996; Frosch, 1996) or, who focus only on customers' "expressed needs", Narver, Slater and MacLachlan (2000) developed a new construct, which they labeled "Proactive Market Orientation". Based on its focus on both customer latent needs

(either solutions to unarticulated customer needs or discovering new needs), Proactive Market Orientation will be utilized in this thesis to better understand Market Visioning Competence with radical innovation.

Narver, Slater and MacLachlan (2000, p. 8) distinguish between "Reactive Market Orientation" ("MORTN": "the attempt to understand and satisfy customers' expressed needs") and "Proactive Market Orientation" ("MOPRO": "the attempt to understand and satisfy customers' latent needs"). This distinction builds on the previous work of Baker and Sinkula (1999), Deshpande, Farley and Webster (1993), Jaworski and Kohli (1993), Kohli and Jaworski, (1990), and Narver and Slater (1990) and their various contributions to the development of the "market orientation" scale. Further, Narver *et al.* found that MOPRO and MORTN were separate but correlated constructs through confirmatory factor analysis, thereby demonstrating discriminant validity of the two constructs. Narver *et al.* used CFA to refine the MOPRO scale to eight items (alpha = 0.884).

2.4.4 Market Learning Tools

There are cases, such as those with Proactive Market Orientation, where deep interaction with customers is simply not possible early during the fuzzy front-end with radical innovations. Here, other techniques for market development and market learning need to be employed, which hinge on the notion of Market Learning Tools that enable and involve scenarios and that do not involve deep interaction with specific customers.

Researchers including Schoemaker (1995), Wheelwright and Clark (1992), and Willyard and McClees (1987) offer several techniques for predicting the manifestations of advance technologies in the marketplace including *scenario planning*, *core driver mapping*, and *science and technology mapping*. These techniques are considered useful tools for readying the firm for the future and they are organizational-level capabilities. The scenario planning method, for example, helps management bound its possible futures by delineating possible and probable outcomes, based on a set of trends that are forecasted

with some degree of confidence as well as uncertainties (Colarelli O'Connor & Veryzer, 2001). Colarelli O'Connor and Veryzer (2001) also describe a process termed *backcasting.* This begins with an imagined end goal, which is worked back to derive the activities that must take place in order to enact that specific version of the future (Davis, 1987; Noori, Munro, Deszsca & McWilliams, 1999). These approaches differ from scenario analysis in that they do not define future scenarios as probabilistic events, but rather focus on end states as desired goals (Davis, 1987; Godet, 1986; Weick, 1969).

Additionally, special forecasting methods have been suggested for learning about potential markets for radically new products including the Delphi technique, Technology Opportunities Analysis (TOA), and technology scenarios such as: the nominal group method, correlation analysis, analytical hierarchies, systems dynamics, cross-impact analysis, relevance trees and scenario analysis (Ettlie, 2000). These are discussed below.

The *Delphi* technique, developed by the Rand Corporation in the 1960s, is a method used to systematically capture and use expert opinions on committees or panels. Three conditions are needed to utilize this technique: complete anonymity for respondents, iteration with controlled feedback and statistical response (Lindstone & Turoff, 1995). Porter's (1994) *Technology Opportunities Analysis* (TOA) technique blends monitoring, forecasting and assessment (much like the Scenario Planning technique of Schoemaker, 1995). Several underlying techniques are used including bibliometrics, analysis of funding levels, and survey of expert opinion to generate the data for use in such analyses. *Technology scenarios* often result from monitoring and assessment exercises. Several of the techniques suggested by Ettlie (2000) (the nominal group method, correlation analysis, analytical hierarchies, systems dynamics, cross-impact analysis and relevance trees) are aimed at generating scenarios from which such analyses can be performed. Based on the ability to tap into several potential futures simultaneously, scenario analysis appears to be an appropriate planning tool for emerging technologies or emerging markets and is, therefore, of interest for this research. Several researchers have

investigated techniques of technology assessment and scenario analysis (Bers, Lynn & Spurling, 1997; Hartmann & Lakatos, 1998; Henriksen, 1997). One scenario analysis technique, which seems to be gaining in popularity, is roadmapping (Barker & Smith, 1995; Kostoff & Schaller, 2000). A science and technology roadmap provides a consensus view of the future science and technology landscape available to decision makers. The roadmapping process provides a way to identify, evaluate and select strategic alternatives (Kostoff & Schaller, 2000). While roadmaps are often prepared by industry associations or governments, they may also be prepared by organizations. Regardless of the origin of preparation, they can provide an important view of potential technology scenarios available to a firm.

Meade and Islam (1998) suggest that forecasting methods that offer *a combination of techniques* tend to outperform individual models. This finding suggests that techniques such as Porter's TOA or technology scenario analysis may be stronger methods for forecasting (Ettlie, 2000) than those relying on singular techniques, particularly in situations where uncertainty is very high, as exists with radically-new products. As such, several market-learning tools exist which, because of their ability to tap into several potential futures simultaneously and also because they build on learning-by-using, they potentially will prove effective for use with learning about or developing markets for radically new-products.

Other techniques, which have been developed for market learning under radical innovation scenarios involve *learning by using* (Rosenberg, 1982). Many researchers (Hamel & Prahalad, 1994; Jolly, 1997; Leifer, McDermott, Colarelli O'Connor, Peters, Rice & Veryzer, 2000; Leonard-Barton, 1995) suggest that the imagination underlying all successful technology-based innovations – that is, the "techno-market insight" – comes from how a problem is approached technically and from an ability to identify compelling benefits of that technology and to characterize these in terms of a market that may not yet exist. Jolly (1997) calls this "marketing flair"; Hamel and Prahalad (1994) call it

"visioning" the future market. In other words, through playing with a technology and possibly by also being a potential customer, market insight may come through the continuous interaction between the user/developer and the technology. For example, Lynn (1993) suggests that intentional use of *patsy markets* is a good "learning by using method" for developing and trying out different network webs and potential applications.

Defining a radical product opportunity with a future market, as described by Veryzer (1998), is largely governed by the development of prototypes with different markets and, therefore, these become an important focus in the study of Market Visioning Competence. This is true, partly because prototypes allow, not only for technical experimentation, but also for experimentation with different markets (patsy markets) in order to see which techno-market interface works best (Lynn, 1993; Lynn, Morone & Paulson, 1996). Early and rapid prototyping allows firms to discover this insight more quickly than the competition, and also inherently increases the rate of experimentation through learning by using (Hamel & Prahalad, 1994; Jolly, 1997; Leifer *et al.*, 1995; Leonard-Barton, 1995; Rosenberg, 1982; Shanklin & Ryans, 1984; Veryzer, 1998).

In sum, Market Learning Tools which have been shown to be most successful with radical innovation, involve those which play on combinations and scenarios for the future: scenario analysis and planning (Barker & Smith, 1995; Bers, Lynn & Spurling, 1997; Hartmann & Lakatos, 1998; Henriksen, 1997; Kostoff & Schaller, 2000; Schoemaker, 1995; 1997), technology opportunity analysis (Porter, 1994), and backcasting (Davis, 1987; Noori *et al.*, 1999). Further, Market Learning Tools have been shown to be most effective when used in combination (Meade & Islam, 1998).

2.4.5 Market Visioning Competence: Developing a Conceptual Framework

Colarelli O'Connor and Veryzer (2001) performed exploratory work using eleven case studies in nine large industrial firms in order to determine what market visioning was comprised of for radical innovations. As with the Lynn and Akgün (2001) research, the

unit of analysis in this study was stated to be "projects". Yet, the phenomenon under investigation actually appears to be "market" visioning. This may suggest that, although the case scenarios had become "projects" at the time of the study, they probably had not reached project status during the visioning process being investigated.

Four qualitative themes emerged from the study by Colarelli O'Connor and Veryzer (2001), in addition to other related literature. These are used as building blocks in this dissertation to develop a framework for Market Visioning Competence. The four themes include: (1) vision is built and sustained through a variety of mechanisms that may operate in combination or serially; (2) there are a number of roles that individuals play in creating and evangelizing a vision through an organization; (3) there exist several tools and methods for aiding in the development of visions, which are not dependent strictly on individual initiative and that are not systematically employed by organizations; and (4) visions undergo a process of validation and internal acceptance that may depend heavily on reaching out beyond the familiar customer/market set of a firm (Colarelli O'Connor & Veryzer, 2001, p. 231). In the case of the first theme, the most important "drivers" of information and ideas occur in the external environment through networking. The second theme involves three key roles—ruminators, champions and implementers—however, the key evangelizers are clearly the champions, according to Colarelli O'Connor and Veryzer. The tools and methods discussed in the third theme are not outlined clearly. Rather, they are mentioned in the context of specific cases where a willingness was shown on the part of some firms to publicize the technology's specifications in the marketplace and then to work with various inquirers in developing applications. The last theme, internal acceptance, is related to the goal of the other three actions and, therefore, is not specifically related to market visioning itself.

The specific themes that emerge from the Colarelli O'Connor and Veryzer (2001) study, which have the most application in describing Market Visioning Competence are Networking, Idea Driving (championing) and Market Learning Tools. Colarelli O'Connor and Veryzer suggest that these themes basically improve our understanding of the nature and

importance of Market Visioning Competence. This thesis, however, goes further through framework development and actual construction of concepts around which to develop a clear understanding of the themes and by which to develop a pool of specific items for testing. Specifically, in this dissertation, market learning is broken out into two separate levels of understanding: Proactive Market Orientation and Market Learning Tools. Proactive Market Orientation was not suggested by the work of Colarelli O'Connor and Veryzer and the specifics of what comprises Market Learning Tools were also not provided in their research. Theoretical support for this distinction was provided above in sections 2.1.6 and 2.1.7 (Organizational Learning and Market Learning). As such, four underlying dimensions for Market Visioning Competence are suggested by the literature review including two individual dimensions (Networking, Idea Driving) and two organizational dimensions (Proactive Market Orientation, Market Learning Tools). The seminal literatures contributing to our understanding of this framework, together with conceptual details, are provided in Table 2.

Table 2
A Framework for Market Visioning Competence

Components of Market Visioning Competence[1]	**Underlying Concepts**[2]	**Supporting References**
Individual Dimensions		
Networking (External)	Network breadth and centrality	Berkowitz, 1982; Granovetter, 1973; Scott, 1990
	Network development speed	Burt, 1992
	Variety of networks	Burt, 1992; Granovetter, 1973; 1983
Idea Driving (Internal)	Champion strength	Howell & Higgins, 1990; Howell & Shea, 2001; Schon, 1963; 1967
	Politicking to gain vision support (internal)	Frost & Egri, 1991; Pettigrew, 1973

Continued on next page

[1] This framework builds on ideas provided by Colarelli O'Connor and Veryzer (2001).
[2] These ideas are based on a broader reference search.

Components of Market Visioning Competence[1]	Underlying Concepts[2]	Supporting References
Organizational Dimensions		
Proactive Market Orientation (External/Internal)	Understand and satisfy customers' latent needs	Narver, Slater & McLaughlin, 2000
Market Learning Tools (External/Internal)	Use of patsy markets (probe and learn)	Lynn, 1993; Lynn, Morone & Paulson, 1996
	Early and rapid prototyping; "learning by using"	Hamel & Prahalad, 1994; Jolly, 1997; Leifer et al., 1995; Leonard-Barton, 1995; Rosenberg, 1982; Shanklin & Ryans, 1984; Veryzer, 1998
	Scenario analysis and planning	Barker & Smith, 1995; Bers, Lynn & Spurling, 1997; Hartmann & Lakatos, 1998; Henriksen, 1992; Kostoff & Schaller, 2000; Schoemaker, 1995; 1997
	Technology opportunity analysis	Porter, 1994
	Backcasting	Davis, 1987; Noori et al., 1999
	Use of a combination of forecasting techniques	Meade & Islam, 1998
	DSS to aid learning process	Day, 1994; Song & Montoyoa-Weiss, 1998

2.4.6 Market Visioning Competence: Underlying Concepts and Capabilities

Colarelli O'Connor and Veryzer (2001) described visioning as a set of skills (competencies), tasks (routines) and processes. In summarizing their exploratory work on market visioning, Colarelli O'Connor and Veryzer (2001, p. 243 - 244) noted:

> This work demonstrates that, although the visioning process is complex, it can be clarified and (better) understood. Further, the nature of visioning as involving different flows and the multifaceted view of the visioning process suggests that there are elements of 'visioning' that can be managed...this broader view of

visioning would seem to suggest that managers interested in enhancing their firm's or department's propensity for innovation (and *market vision*) should focus on providing each component of the visioning process and insuring that sufficient links or interplay exists among them.

Therefore, each of the underlying concepts in the framework (presented in Table 2) can be thought of as components of the visioning process and how well they are done is related to capability or competence. It is important to note here that in the management literature, the terms capabilities, competencies and resources are used interchangeably and there is no consensus regarding their usage. According to Doz (1997) and Leonard-Barton (1992), the heart of competence management is rooted in skills, technical and management systems, specific assets and values and these are reflected as wider value-creating competencies. Hall (1993) has delineated what he calls "intangible resources" into the "having capabilities" and the "doing capabilities". Assets, such as organizational and individual networks, would be considered by Hall to be purely "having capabilities". Skills, such as know-how for alliances, would be considered by Hall to be "doing capabilities". Some capabilities include both "doing" and "having". For example, systems such as decision support systems, would be considered by Hall to be both a "doing" and a "having" capability. In Table 3, the concepts underlying Market Visioning Competence are detailed as elements of competence, as delineated by Doz (skills, systems, assets, values). The table demonstrates not only the aspect of the competence, which will be measured (i.e., speed, quality, strength) in this research, but also at which level(s) the competence occurs (i.e., individual, organizational or both).

Table 3
Concepts Underlying Market Visioning Competence

Market Visioning Variables[1]	**Underlying Concepts**[2]	**Type of Competence**[3]
Networking	Network: breadth, variety, centrality	Asset(Quality, Strength, Size)
	Network development speed	Skill (Speed)
Idea Driving	Champion strength	Skill, Values (Strength, Quality)
	Politicking to gain vision support	Skill, Values (Strength, Speed)
Proactive Market Orientation	Understand and satisfy customers' latent needs	Skill (Quality, Speed)
Market Learning Tools	Use of patsy markets	System, Skill (Quality)
	Early and rapid prototyping	System, Skill (Speed)
	Scenario analysis and planning	System, Skill, Values (Quality)
	Technology opportunity analysis	System, Skill (Quality)
	Backcasting	System, Skill (Quality)
	Combination of forecasting techniques	System, Skill (Quality, Strength)
	DSS to aid learning process	System, Skill (Speed, Quality)

2.5 Conceptual Foundations: Early Performance

Finally, in order to develop insights about the likelihood of new product success engendered by Market Vision and Market Visioning Competence at the fuzzy front-end of NPD, this research requires an *Early Performance* metric. Typical project-level measures of success include market share, revenue, revenue growth, unit volume, number of customers, profitability, margins, IRR, ROI, break-even time, speed to market, total development cost and time-to-launch (see Griffin & Page 1996 for a complete review). Since Market Vision deals with the early, pre-project stages of radical innovation involving advanced technology, most of the standard measures of project-level performance are inappropriate. Not only are most of these measures temporally far-

[1] This framework builds on ideas provided in research by Colarelli O'Connor and Veryzer (2001).
[2] These ideas are based on a broader reference search.
[3] This framework builds on ideas provided by Doz (1997).

removed from the FFE of NPD in the case of radical innovation, but for many companies interviewed for this research, they have not launched products yet—and so, these measures are not relevant or meaningful for them.

One of the challenges, therefore, is that on the one hand it is obviously important to make decisions that will lead to strong Early Performance; at the same time, only limited theory exists regarding how to evaluate performance during and as a direct result of activities in the FFE. In light of these concerns, von Hippel's (1978) "lead user" concept and various findings from Griffin and Page's (1996) project-level success measurement study, provide insights for developing an Early Performance metric for radical innovation that would provide meaningful outcomes in the case of Market Vision.

Lead users are those who face needs that will be general in the market months or years before the bulk of the marketplace encounters them (von Hippel, 1978). Such users are positioned to benefit significantly by obtaining a solution to those needs and therefore, it is likely that they will be drawn to those suppliers/manufacturers which look like they hold promising ideas for successful product delivery in the future. Further impetus for using "success with early customers" as an outcome measurement, in general, comes from the research of Griffin and Page (1996) which found that such an outcome (measured by both satisfaction and acceptance), is particularly important for measuring success with "new-to-the-world" products. In particular, Griffin and Page (1996) suggest that if customers do not accept a product in the first place, no sales will result. As such, satisfaction and acceptance by early customers, such as lead users, provide Early Performance measures for understanding the future promise held within Market Vision.

The findings of Griffin and Page's (1996) measurement study also point to a third important measure which could be applied in the case of new-to-the-world products: "technical competitive advantage". This measure was rated the third most effective measure in the case of new-to-the-world products, after customer acceptance and satisfaction, by the respondents of the Griffin and Page study. Clearly another advantage

of utilizing technical competitive advantage as an Early Performance item is related to the temporal issue that it can be utilized during the early stages of FFE of NPD with radical innovations.

2.6 Summary

Based on the literature review, it is proposed that Market Vision, in the case of radically new products, is preceded by Market Visioning Competence. Market Vision, according to this dissertation, is proposed to be a clear and specific mental image (or mental model) that organizational members have of a desired and important market for a new technology. This image includes potential users, a potential product concept and the potential interaction of user and product in the environment and in the marketplace. Market Visioning Competence, according to Colarelli O'Connor and Veryzer (2001), is the ability to link advanced technologies to market opportunities of the future, i.e., the market vision. These two constructs, Market Vision and Market Visioning Competence, based on the extant literature, seem sufficiently important, complex and different from one another, to warrant further investigation to discover their specific nature and make-up, as well as how they are related.

The next chapter of this dissertation presents an evaluation of the literature, in order to show both its limitations and the critical gaps that still exist in this area of research. This will suggest the contributions, which can be made as a result of the research carried out and described in this dissertation. The limitations and research gaps in the current literature lead to a set of research questions and related hypotheses, which are then tested and discussed.

Chapter 3: Evaluation of Existing Literature

In this chapter, the limitations and critical gaps in the extant literature, in the areas of Market Vision and Market Visioning Competence, are described in order to identify and describe the contributions made by the research undertaken in this dissertation. Following this, the structural, causal and moderating relationships for the conceptual model are hypothesized. Finally, the variables and situations which will not be tested are justified.

3.1 Conceptual Limitations and Research Gaps

There are several important gaps in our knowledge regarding Market Vision. A first major limitation noted by Crawford and DiBenedetto (2000) and also by Brown and Eisenhardt (1995) is that there is surprisingly little research on the concept of vision, in general. Not only do we lack understanding as to what comprises a Market Vision, but we also do not have a good understanding of how market visions are formed and what their impact on Early Performance might be. The next sections discuss these three key limitations to the extant literature.

3.1.1 What Comprises a Market Vision?

While highly desirable for firms, the actual composition of Market Vision is not well understood. Specifically, Brown and Eisenhardt (1995, p. 370) discuss their concern that "our understanding of exactly what vision is, what an effective product is, and the theoretical links between the two is very weak". This indicates that Market Vision as a research topic has been relatively unexplored and suggests a first major limitation of theory in this area. Several studies (as per the literature review) have suggested variables that may contribute to our understanding of what Market Vision is. Those studies, however, which have investigated vision and visioning, have done so using

different levels of analysis: Organizational Vision (Collins & Porras, 1991; 1995; Hamel & Prahalad, 1994), Project Vision (Lynn & Akgün, 2001) and Market Visioning (Colarelli O'Connor & Veryzer, 2001). Moreover, with the exception of the study on Project Vision performed by Lynn and Akgün (2001), this research has been exclusively qualitative in nature. As shown in the literature review, while some of these variables have been operationalized (for example, the extrinsic components of vision—clarity and support—in Lynn and Akgün's work, 2001), most have not been articulated in measurement terms (for example, the intrinsic components of vision have been described only qualitatively in the work of Collins and Porras, 1995 and others). Thus, operationalizing the MV construct in terms of the specific variables it comprises and in terms of measurement scales is one key task which is required in order to do any empirical testing of Market Vision.

Another problem relating to past studies is that researchers have tended to apply the same concepts even though they were dealing with different levels of analysis. For example, the extrinsic factors utilized by Lynn and Akgün (2001) to measure Project Vision are exactly the same as those suggested by Hamel and Prahalad (1994) to measure Organizational Vision. This has created some confusion. On the one hand, while the basic concepts of Market Vision are relevant at all levels, there is evidence to show that vision itself changes at different levels of analysis as well as the nature of its underlying dimensions. This is the case with the extrinsic (i.e., Clarity and Support) and intrinsic (i.e., Form, Scope, Magnetism) Market Vision factors which have been described in the literature. Although they all play a role at each level of analysis, their specific nature and valence may differ across these levels. In other words, the emphasis of each element may shift as vision and technologies move through the NPD process. As an example, in their discussion regarding Project Vision, Lynn and Akgün (2001) suggest that vision clarity is the first step in creating an effective vision and that, without a clear vision, it is unlikely that others will support it and that it will become stable over time. Collins and Porras

(1995), however, demonstrate that vision clarity is absent at many of the greatest hi-tech companies that they studied. For example, in 1937, when Bill Hewlett and Dave Packard formed HP, they decided to start their company first and then, over time, figured out what they would produce. These companies did not begin with a clear vision in mind. This suggests that vision, in the case of advanced technologies, is typically the result of an emergent process and is, therefore, related to the type of emergent or "bottom-up" strategy (see Mintzberg, 1979). It also suggests that clarity is an important component of vision; but, one that becomes stronger over time as vision evolves from the product-market level to the project level to the organizational level.

Although some progress has been made, a good deal of work remains to be done in distinguishing and eventually linking together these separate levels of understanding for the concept of vision, and to understand the shifting importance of the underlying components comprising vision as it moves from one level of analysis to another. The idea of vision as adapting through a range of progressively more elaborated and detailed forms, with different focus and amount of support at each vision level (i.e., market, project, organizational), is an appealing one with regard to radical innovations. A mental model of a target market may, therefore, begin as a generic form, getting more detailed with time and elaboration as the technology and product develops through informal and formal stages of development. A challenge in this dissertation is to see which of the extrinsic and intrinsic elements are important in the case of Market Vision.

A further limitation related to our understanding of vision, as it has been presented in the literature to date, is related to the terminology used. The terms "visioning" and "vision" are often used interchangeably. Colarelli O'Connor and Veryzer (2001), Hamel and Prahalad (1994) and also Lynn and Akgün (2001), while not stating it explicitly, indicate that there are two separate aspects: visioning, which refers to a process and capability, and vision, which is an end-state. Therefore, in addition to identifying what the concept of Market Vision is specifically comprised of, this thesis also develops a

comprehensive and clear understanding of "visioning" and "vision" as two separate constructs, and tests that these two constructs are indeed distinct entities.

3.1.2 How are Market Visions Developed?

Based on the literature, it is proposed that "Market Vision", in the case of radically new products, is preceded by a period of "Market Visioning", and that, as noted above, these two constructs are distinct. Therefore, it is necessary to develop an in-depth understanding not only of what Market Vision is, but also of the antecedent construct, Market Visioning Competence.

As developed in the literature review, *Market Vision* for discontinuous innovations can be defined as *a clear and specific mental model or image that organizational members have of a desired and important product-market for a new advanced technology. This image includes potential users, a potential product concept and the potential interaction of user and product in the use environment and in the marketplace.* Such a vision serves to direct organizational members' awareness to a market end-state or goal, thereby allowing them to focus attention on those market application issues relevant for new products that stem from a given advanced technology (Hamel & Prahalad, 1994; Lynn & Akgün, 2001; Collins & Porras, 1995). But, how do companies develop a useful Market Vision? As suggested in the literature (Burt 1992; Colarelli O'Connor & Veryzer, 2001; Granovetter, 1973; Howell & Shea, 2001; Narver, Slater & MacLauglan, 2000; Schoemaker, 1995), for radically-new products, it is often the informal (e.g., Idea Driving) and external (e.g. Networking) individual activities and the organizational market-related capabilities (e.g., Proactive Market Orientation and Market Learning Tools) that play an important role in creating a vision of a potential future product-market outcome. Thus, *Market Visioning Competence* is comprised of *a set of individual and organizational capabilities that enable the linking of advanced technologies to a given market opportunity of the future* (based on Colarelli O'Connor & Veryzer, 2001), and do so through a shared mental model of such a potential future product-market (the Market Vision itself). Therefore, while Market Visioning Competence can be seen as a set of capabilities within the

firm linked to Market Vision, Market Vision is the market-related mental model that results from these capabilities. This idea of the relationship between these two constructs, building on the literature, enables the development of hypotheses, which deal both with the composition of the constructs and with their potential relationship.

3.1.3 Impact on Early Performance of Market Vision and Market Visioning Competence

A third limitation of the research on vision is related to the lack of objective empirical data linking vision to some type of outcome. Despite many case studies and company histories (Collins & Porras, 1991; Hamel & Prahalad, 1994; McAlister, 1998), which suggest that there is a link between vision and success in the marketplace, only one study has empirically investigated this link using a relatively large-scale sample of cases (Lynn & Akgün, 2001). The results of this particular study, which was carried out at the project level, indicate that for radical innovations, vision clarity is significantly related to new product project success. Success in this study was measured in terms of a composite construct including nine items, all of which were typical post-launch metrics (e.g., ROI, sales and profits). Because this study was at the project level this measure was appropriate. This limitation highlights the need for, not only further research of this nature, but also for research into outcomes that are tied more closely temporally to MVC and MV, which are relevant to the FFE of innovation development.

The need for further research on what is a positive outcome resulting from a vision at a given level—i.e., project, market, organizational—is also tied to the need to influence managers regarding the importance of creating and supporting the necessary competencies that will enable strong and effective vision to flourish. Some of the competencies that are likely required are suggested by Gupta and Wilemon (1996) in a study in which they found that R&D directors give top priority to monitoring market developments and having technology commercialization capabilities. Gupta and Wilemon report that even though these two capability areas are viewed as having the highest importance for an R&D program in terms of

potential impact on Early Performance, they are also functions for which companies have the least capabilities. Ability to monitor market developments and visualization of how technology might be commercialized are critical components of Market Visioning Competence and Market Vision, respectively. Given that inability to understand and perform these functions are barriers to Early Performance (Khurana & Rosenthal, 1998; Murmann, 1994), investigations into how to reduce this crucial gap between competencies that companies need, yet do not have, are imperative. Market Vision and Market Visioning Competence have not been put together in a comprehensive model or tested empirically in terms of their contribution to firm advantage, and as such, represent a key area of opportunity for investigation.

3.2 Methodological Limitations and Solutions

Investigations of market visioning and different types of vision for discontinuous innovations, in general, have proven to be challenging for researchers. This is due to the problem associated with isolating levels of analysis (i.e., market, project, organizational levels) and, also, the challenge associated with collecting adequate-sized samples of data from the smaller, more inaccessible research populations and personnel that tend to be involved in radical innovations. Despite these methodological challenges, researchers have cited both important gaps in our knowledge regarding vision which need to be acknowledged and addressed, and the importance of further investigation in this area. As such, a research population which would enable overcoming some of these limitations is desirable. Additionally, addressing a specific unit of analysis and level of analysis would help provide more focus to this topic.

3.2.1 Research Population and Personnel

The first important challenge related to the study of Market Vision and Market Visioning Competence involves the research population. Often, in the case of radical innovation,

both the number of industries and the size of firms involved in such ventures tend to be small (Ettlie, 2000). Therefore, individuals in small firms tend to be "jacks-of-all-trades", often too busy to take part in interviews or surveys. Fortunately this scenario is changing. Although, historically, it has tended to be small firms and individual entrepreneurs that were primarily responsible for most new developments occurring at the radical innovation level—work by Chandy and Tellis (2000) shows that over the last 150 years, small firms and non-incumbents introduced more radical product innovations than large firms and incumbents—this phenomenon is gradually changing. Since WW II, large firms and incumbents have become much more sophisticated players, using new strategies such as strategic alliances, and are now responsible for the introduction of the majority of radical innovations. In other words, while historically it was difficult to quantitatively assess radical innovation because of small and difficult-to-access populations, this situation is changing. For example, the nanotechnology industry, the source of data of two of three studies in this dissertation, is expected to have a large impact on a great number of industries and there are many known incumbents that are involved in current developments in this industry.

Related to this first challenge of smaller, less accessible firms is the issue of accessibility of personnel for interviewing. In this dissertation, this challenge of gaining access to informants is addressed by utilizing the nanotechnology industry as a survey population. Because the industry is relatively young, respondents have not experienced the same level of "survey fatigue" as other, more seasoned, industries (e.g., pharmaceuticals and biotechnology). In fact, during the dissertation research, many respondents mentioned that this was the first academic survey that they had taken part in.

3.2.2 Unit of Analysis

The second important methodological challenge, in investigating Market Vision and Market Visioning Competence, is assigning a unit of analysis which is common to these

constructs. This is important because Market Vision and Market Visioning Competence will be assessed simultaneously in the modeling component of this paper.

Market Visioning Competence serves as a facilitator in the organizational new technology adoption process and determines, for the organization, a range of potential product application(s) which could be pursued, based on given technology(ies). Market Visioning Competence links the Technology Vision (i.e., the "platform-technology level" described in Figure 2, Chapter 2) with the Market Vision (i.e., the "product-market level"). In other words, Market Visioning Competence has the potential to provide a range of options through what is known as "divergent visioning" for a given technology (Colarelli O'Connor, 1998). Thus, Market Visioning Competence is related to the development of technology in terms of moving forward potential market applications (through Networking, Market Learning Tools, etc.), which will affect programs and platforms emanating or resulting from the technology in the future. Specifically imagined and desired markets of the future, which are related to Market Vision, are more closely tied to specific products or goals through the product-market interface than technology vision. This is so because for vision, as distinct from visioning, the goal (in this case the product for a market) is part of the vision (Christensen, 1997; Cummings and Davies, 1994; Jolly, 1997; Rice *et al.*, 1998; Stokes, 1991). The unit of analysis, however, which is constant throughout this process—that is, movement from the platform-technology level to the product-market level—is the technology itself. Many products may be created by the firm, stemming from an initial technology; however, it is the generic technology which remains the same throughout, as described in the literature review. As suggested by Schon (1967, p. 8), "bringing new technology into being is a complex process in which goals are discovered, determined and modified along the way". As such, while the goal component of vision becomes more concrete and sometimes is modified through the process of a generic technology becoming incorporated into a product, the generic technology itself remains unaltered. As such, the technology provides a good unit of analysis for this research.

A further level-of-analysis issue with the proposed research again involves the bottom-up directionality of information flow with radical innovations. As described, such an information/idea flow usually begins with individuals (technical level), moves upward to small-groups or teams (product and project levels) and then on to the organizational level (Crossan, Lane & White, 1999). While the "technology-as-unit-of-analysis" approach should overcome any statistical problems associated with the inclusion of comments from individuals on both individual-level items and those that occur at the broader level of the organization (Robinson, 1950), there is still a concern that individuals from small-group clusters (e.g., team members) and senior managers may be representative of two predominantly distinct "collective views" within the organization (Gonzalez-Roma *et al.*, 1999). As such, representatives from each of these views will be included in the sampling process.

3.3 Proposed Contributions

The findings of Anderson and Tushman (1990), Christensen (1997), Tushman and Anderson (1986) and others demonstrate that, in the case of discontinuous innovation, "competence-destroying-technologies" are likely to determine market advantage. This said, it is still unknown why, while hundreds of companies may introduce "competence-destroying-technologies" in emerging markets, only an extremely small number will emerge with market advantage. It is proposed in this dissertation that it is Market Vision that is the distinguishing characteristic that allows certain organizations to achieve such advantage. This is because competence in Market Visioning helps firms to move more quickly towards developing a shared mental model of a future market (i.e., the Market Vision), and it is this mental model that facilitates achieving an early competitive advantage by enabling the firm to focus more specifically on those activities which move it towards achieving the vision. Going back to the example in Chapter 2, the product-market involved optical switches with a biochemical enhancement technology for

international telecommunications companies. This type of Market Vision might motivate the firm to make contact with appropriate venture capital companies, to secure new hires with the right expertise for further development, and to make contact with potential customers for concept tests, and to undertake further testing (alpha and beta). These early undertakings would give firms competitive advantages that might parlay into longer-term success once in the marketplace. Developing a better understanding of Market Visioning Competence and Market Vision and their potential impact on Early Performance, therefore, will contribute to a greater understanding of how firms can achieve advantage in the case of discontinuous innovation.

Although studies have dealt with vision at the generic, organizational and project levels, at the product-market level both Market Visioning Competence and Market Vision have not been adequately investigated. While Market Visioning Competence has been explored only qualitatively with a small sample of industrial companies (Colarelli O'Connor & Veryzer, 2001), Market Vision has not been investigated or tested either qualitatively or quantitatively. Additionally, the impact of vision on Early Performance has been tested only at the project level. Given the importance and rationale for conducting this research, both for managers and academics, this dissertation focuses on theory construction and on the development of scales for measuring Market Visioning Competence and Market Vision. In order to facilitate this, this thesis examines the nature and underlying dimensions of both of these constructs, in the case of radically-new, high-tech products. Comprehensive and detailed scales for measuring Market Visioning Competence and Market Vision have yet to be developed and, therefore, are considered an important part of the contribution of this dissertation. Based on the literature review, a central proposition is, that for radically-new products, Market Visioning Competence and Market Vision comprise two separate constructs, each of which impact corporate Early Performance, separately. Further, it is proposed that Market Vision can have a greater impact on firm Early Performance in the marketplace if Market Visioning Competence is

better developed. The review of the literature shows that these research objectives have not been explored previously in either the new product development literature or the technology and innovation management literature. A further aim is to help firms improve Market Visioning Competence and Market Vision, in situations where it matters most (i.e., with radical innovation), in order to offer themselves the best possible chance of market success with radically-new high-tech products.

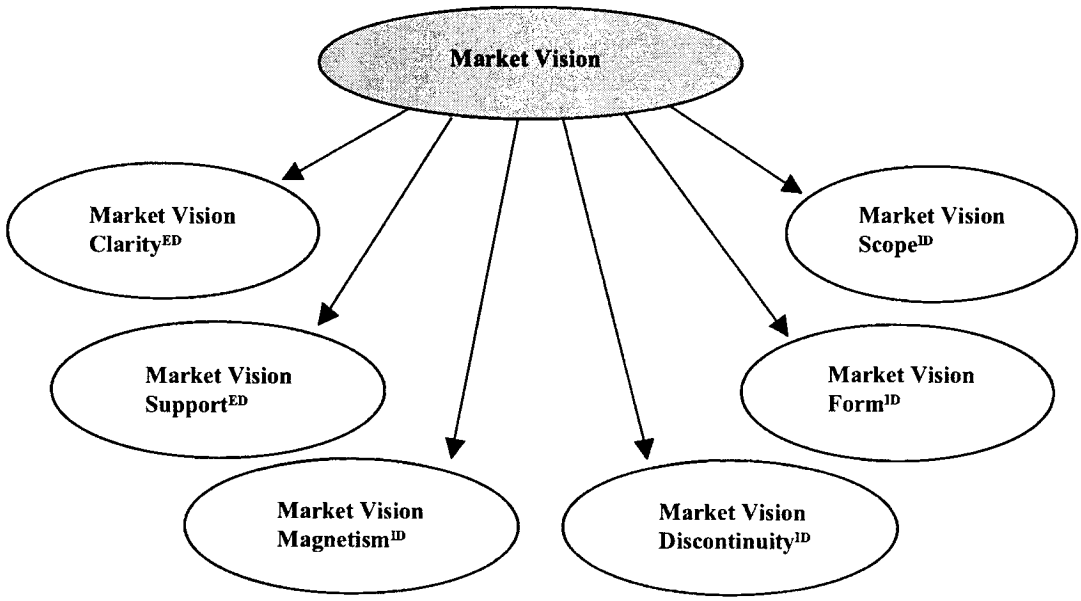
3.4 Model and Hypotheses

Firms achieve success with radical new technologies in the marketplace by doing two things well. First, they must choose a specific market application which ultimately will be profitable, where possible ahead of future competitors, and one where they can best leverage their technical and marketing capabilities. Second, the interface between the new product (within which resides the new technology) and the customer must also be effective. In other words, as described in the literature review, the use by firms of new technologies through the delivery of products to the marketplace results in variance (i.e., through a variety of market applications and product-market interfaces enacted by all firms involved with the technology) and in a resultant selection in the environment so that some firms are successful and some are not (Nelson & Winter, 1982). It is therefore important for firms to focus on those capabilities, which will give them the best possible chance to select the best markets and to envision good product-market interfaces which will result in success with radical innovation (Hunt & Morgan, 1996; Tushman & Anderson, 1986). Appropriate and faster-than-competition market application selection can be strongly impacted by an effective Market Visioning Competence. Being able to envision a good product-market interface goal, capable of effectively directing NPD, is achieved through Market Vision. Based on a co-evolutionary approach, where both firms and environments can impact future successes (Baum & Singh, 1994; Rosenkopf & Tushman, 1994; Van de Ven & Garud, 1994), such competence involves both learning

quickly from the environment and at the same time impacting the environment by initiating disruptive variance through effective market selection and product-market interfaces that are considered successful by customers in the market. While learning and creating variance go hand-in-hand with a co-evolutionary approach, there is a presupposed flow of movement from learning to variance, rather than the other way around, particularly in situations where proactive actions are involved. Notwithstanding this temporal sequence (learning or developing a Market Visioning Competence before creating variance through Market Vision), given that the main objective of this study is to develop a better understanding of Market Vision itself, the dissertation starts by examining the variance aspect first—that is, Market Vision.

Market Vision facilitates the ability of a firm to initiate disruption in its environment as it provides a rallying point, or end state, around which people can begin to build an understanding of a potential product-market interface for a new technology. As described in the literature review, various perspectives have been utilized to build a conceptual framework for an understanding of what Market Vision is potentially comprised of, that is: extrinsic factors including MV Clarity, MV Support and MV Magnetism, and intrinsic factors including MV Discontinuity, MV Form and MV Scope. One of the main objectives of this dissertation is to test the validity and reliability of this structure. Hence, the following hypothesis (H1) suggests this second-order structure for Market Vision and its various first-order dimensions (see Figure 4).

> **Hypothesis 1 (H1):** Market Vision is a multidimensional second-order construct that is formed by six dimensions: MV Clarity, MV Support, MV Magnetism, MV Discontinuity, MV Form, MV Scope.

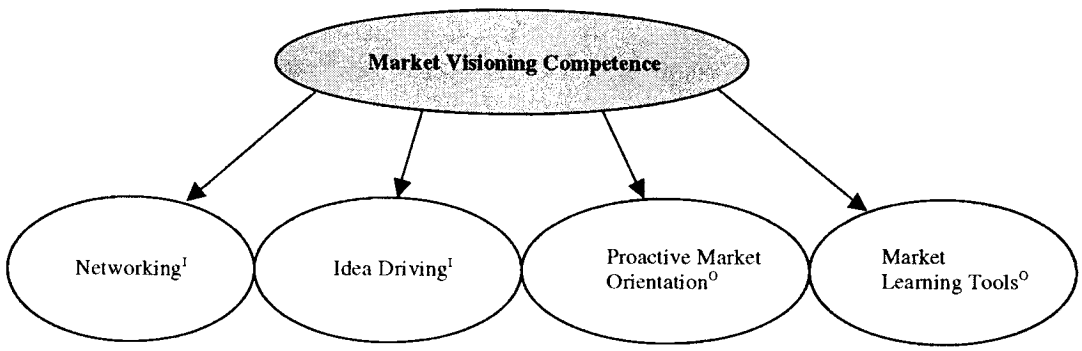


ED = Extrinsic Dimensions ID = Intrinsic Dimensions

Figure 4. Hypothesized Conceptualization of Market Vision

As noted above, Market Visioning Competence involves the process and ability to undertake rapid learning from the environment (Baum & Singh, 1994; Rosenkopf & Tushman, 1994; Van de Ven & Garud, 1994). As described in the literature review, organizational learning from the environment may involve technical learning and market learning. Both types of learning are facilitated through "Networking". In the case of market learning, utilizing a variety of forecasting techniques, maintaining strategic flexibility with respect to new markets (i.e., "Market Learning Tools") and directly dealing with potential markets (i.e., "Proactive Market Orientation") are seen as primary facilitators. Further, the driving of new ideas forward within the organization so that they ultimately lead to products in the marketplace impacts learning in the environment (i.e., "Idea Driving"). Market Visioning Competence is reflected in the nurturing and development of these capabilities. Market Visioning Competence, therefore, is hypothesized to be reflected by a combination of individual and organizational capabilities involving Networking, Idea Driving, Proactive Market Orientation and Market Learning Tools (see H2 and Figure 5).

Hypothesis 2 (H2): Market Visioning Competence is a multidimensional second-order construct that is formed by four dimensions: Networking, Idea Driving, Proactive Market Orientation and Market Learning Tools.



I = Individual O = Organizational

Figure 5. Hypothesized Conceptualization of Market Visioning Competence

The elements of Market Visioning Competence can be used by firms to create a shared focus for the future (i.e., Market Vision). This is so because firms that are competent with market visioning are able to move more quickly to shared mental models of future markets (Market Vision). The main arguments underlying this proposition were outlined in section 3.1.2 and the result is the hypothesis that Market Visioning Competence has a positive impact on Market Vision (H3).

Hypothesis 3 (H3): Market Visioning Competence positively impacts Market Vision.

Market Vision should have a positive impact on Early Performance, particularly on those items which are related to the ability to satisfy and attract early customers. The logic underlying this is related to having a vision of the point of interaction between potential customer and potential product—that is, the Market Vision Form—and having a

vision that provides radically new benefits to the customer—that is, Market Vision Discontinuity—enables the firm to move forward in a way which is likely to meet customer needs and wants, especially those of lead users (von Hippel, 1978; 1986). Lead users are those who face needs that will be general in the market months or years before the bulk of the marketplace encounters them. Such users are positioned to benefit significantly by obtaining a solution to those needs (von Hippel 1978). At the same time, the Market Vision Magnetism element of Market Vision helps to ensure this because individuals in the firm are more likely to be attracted to a goal that has a good possibility of having an impact on the market, as evidenced by Market Vision Scope. Much of the early research in the NPD area supports this idea. Pursuing large and important target markets has been found in such research to play out in terms of success (e.g., Cooper, 1979; 1984; de Brentani 1989) and, therefore, these types of markets represent attractive opportunities. While there have been some researchers who suggest that such large markets do not exist in the discontinuous or radical scenario (e.g., Christensen, 1997), in reality this tends to be only a short-term phenomenon. It is the ability to forecast the future potential for a market in terms of importance and size that is important, particularly in terms of firing up employee's imaginations. Many of the individuals interviewed for this dissertation described their current markets as small and probably not their "final targets"; but that they were using them to learn about and build competence with the technology. This backs up the idea suggested by Gary Lynn and his team (1996) of the importance of patsy markets and "probing and learning" for building competence through the learning involved with small or current markets, while dreaming about and working towards much larger opportunities of the future. The Market Vision Clarity and Market Vision Support elements play an important role in moving the firm more quickly to a shared vision of the future product-market. Speed is particularly important in moving towards acceptance at the project level, which should translate ultimately to moving more quickly through the product development process on the whole. This converts into being able to beat potential

competitors to the marketplace, and also helping to ensure that the needs and wants of customers do not change too drastically during the time prior to launch (Lynn and Akgün, 2001). In sum, an effective Market Vision allows individuals in the company to focus on delivering unique benefits to the customer in a user-friendly environment. If individuals in firms are focused on delivering this Market Vision, it will play out in terms of success with lead users. As such, Market Vision is hypothesized to have a positive impact on Early Performance (H4).

Hypothesis 4 (H4): Market Vision positively impacts Early Performance.

The primary impact of Market Visioning Competence, in terms of Early Performance, can be expected to be on those items related to attracting sources of financing to the project. The capabilities comprising Market Visioning Competence—i.e., Networking, Idea Driving, Market Learning Tools and Proactive Market Orientation—are all important for gaining the attention of financiers. Specifically, Idea Driving helps draw attention to the Market Vision (Howell & Higgins, 1990; Howell & Shea, 2001) internally, which may translate into gaining external acceptance with financiers because there are more people who can become involved with the external networking process to bring potential financiers to the table. External Networking enables contact with external financiers such as venture capitalists or investment bankers either directly or indirectly (financial capital) (Zider, 1998). A Proactive Market Orientation, together with external Networking, has the potential to draw financial resources to the project through the collection of new and interesting market information that may lead to competitive advantage (Narver, Slater & MacLaughlin, 2000). Lastly, Market Learning Tools, because they may enable several potential market scenarios for a given technology (Porter, 1994; Schoemaker, 1995; 1997), can be exciting to investors as they may see both short- and long-term market opportunities for the technology platform that is developing. In other

words, the shorter-term technical capabilities that are being developed in support of a given platform may have the potential to be leveraged to build stronger and new capabilities that enable development of future longer-term product-market opportunities (Wheelwright & Clark, 1992). The ability to develop these scenarios is facilitated through Market Learning Tools. As such, a Market Visioning Competence ensures that a company is able to secure the necessary capital to continue with the venture. Therefore, it is hypothesized that Market Visioning Competence has a significant impact on Early Performance (H5).

Hypothesis 5 (H5): Market Visioning Competence positively impacts Early Performance.

This combination of Market Visioning Competence and Market Vision allows the firm to move more quickly and effectively toward achieving competitive advantage. In other words, firms that are competent at market visioning and have strong and effective market visions are likely to perform well early on in the marketplace with radical innovations. Hence, three hypotheses are constructed with respect to Market Vision, Market Visioning Competence, and Early Performance (see H3 - H5 and Figure 6).

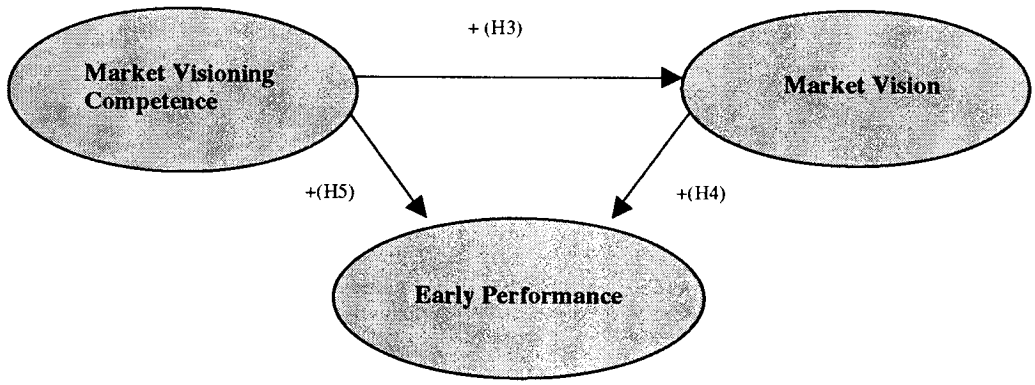


Figure 6. Conceptual Model of Relationships Between Market Visioning Competence, Market Vision and Early Performance

3.5 Moderating Hypotheses

Understanding how Market Visioning Competence impacts the formation of a Market Vision and how this is translated into Early Performance, is enhanced through the inclusion of moderators which may have an important impact on these primary relationships. The impetus for choosing firm characteristics, technology factors and competitive effects as moderators comes from the work on diffusion of radical product innovations by Gatignon and Robertson (1986), Robertson and Gatignon (1986), Montaguti, Kuester and Robertson (2002) and Kim, Bridges and Srivastava (1999).

The adoption of a radical technology by a firm, for the purpose of developing radical innovations, is facilitated by Market Visioning Competence and the way it will be applied takes shape through Market Vision. Diffusion of technology into the firm is related to "adoption" or demand by the firm. Gatignon and Robertson (1986) refer to this as the demand side of diffusion and suggest that it is likely to be influenced by three firm-level factors: Origin Relatedness, Resource Availability and Firm Size. These factors, because they facilitate diffusion and adoption by the firm, are considered to be moderators of the relationship between Market Visioning Competence and Market Vision. Further, once a Market Vision has formed, technology factors (Appropriability), competitive environment factors (Industry Concentration, Incumbency, Reputation) and another group of firm-level factors (R&D expenditures and Marketing expenditures, Order of Entry) are likely to impact the extent to which Market Vision influences Early Performance in the marketplace (i.e., according to Gatignon and Robertson, 1986: the supply side of the diffusion equation). Each of these factors is described in the following two sections: Moderators of the Market Visioning Competence to Market Vision Path, and Moderators of the Market Vision to Early Performance Path. The last set of firm-level moderating factors (R&D expenditures, Marketing expenditures and Order of Entry) are described at the end of this section; however, for reasons that will be provided, they will not be tested in the context of this dissertation.

3.5.1 Moderators of the Market Visioning Competence to Market Vision Path (Demand Side of Diffusion)

3.5.1.1 Origin Relatedness. Firms are inevitably constrained in their choice of innovation strategies, including selection of a product-market, by their accumulated skills, organizational newness and by the technological opportunities they are capable of exploiting. In other words, where a firm can go, in terms of its involvement with a technology, is largely a function of its current position, which is often shaped by the path it has previously travelled (Baum & Singh, 1994; Goodman & Lawless, 1994). As Teece, Pisano & Shuen (1997) put it: history matters. Given that Market Visioning Competence involves the development of a technology towards a future market application, for firms in which accumulated skills are not highly related to the technology opportunity, it will require much more effort to drive support for and involvement in the new technology. Therefore, technological synergy offers a potential avenue to success in these situations (Cooper, 1979). Also, because firms do not easily cannibalize specialized investments (Chandy, 1996) and because they tend to operate on platforms that are already developed (Wheelwright & Clark, 1992), they are less likely, or at least usually slower (Griffin, 1993), to get involved with "competence destroying" technologies. According to Tushman and Anderson's (1986) findings in the minicomputer, cement and airplane industries, newcomers have the advantage only for new products that undermine the competence of veterans (i.e., those that are competence destroying); in all other cases, veterans have the edge (i.e., those that are competence enhancing). These findings are borne out by the research of Lambkin (1988).

Similarly, market synergy (or the ability to leverage market competencies) also aid firms in linking advanced technologies to market opportunities of the future (Cooper, 1979). While a firm may not have experience with a given market channel or target market, other market competencies (for example, a strong sales force that understands the technology) can lend themselves to success in unfamiliar market situations.

Therefore, leverage of market competencies also should be considered in a discussion of origin relatedness.

Thus, Origin Relatedness, or the connection between the prior experience of the firm and the new venture (Bolland & Hofer, 1998), can be expected to have an important impact on the firm in using its Market Visioning Competence effectively to create the "right" Market Vision. If new technologies are competence destroying, Origin Relatedness for incumbents will be low, cycle time will be slow (Griffin, 1993), and it is likely that incumbents will find it difficult to develop visions that have a high level of discontinuity. In such cases, therefore, the lower the level of Origin Relatedness, the lower the impact of Market Visioning Competence on Market Vision. Alternatively, the higher the Origin Relatedness, as might be the case with a competence-enhancing technology for an incumbent, or a competence-destroying technology for a newcomer, the more positive the impact between Market Visioning Competence and Market Vision.

> **Hypothesis 6 (H6):** Higher levels of Origin Relatedness will have a positive impact on the relationship between Market Visioning Competence and Market Vision.

3.5.1.2 Resource Availability and Firm Size. "Slack resources" (Bower, 1970) often act as a buffer for organizations by reducing the impact of immediate competitive and financial pressures from the environment. In other words, all other things being equal, slack resources buy time for firms that are in the process of learning about new technologies and markets. Moreover, it is often larger, established firms that have the advantage of Resource Availability—in the form of financial capital, information resources and social capital—which helps them to leverage their learning experience and drive forward involvement with new innovation while also acting as buffers against environmental pressures. Levinthal (1994) describes the situation whereby a firm has ties to its various

constituent groups or stakeholders (i.e., labor, government, suppliers and sources of capital) as a form of social capital. Long-standing relationships, channel power and firm reputation, each can impact the relaxing of external demands and enhanced resource availability in a manner that small start-ups are not necessarily afforded. Such available ("slack") resources have been suggested by Bower (1970) as able to give large firms an advantage under conditions of involvement with radical innovation. These firms have an advantage because slack resources permit them to build better networks, build better systems for market learning and hire the best possible individuals capable of driving forward new ideas—that is to build better Market Visioning Competence. Interestingly, Firm Size can also be seen as a hindrance in the case of radical innovation (Burgelman & Sayles, 1986; McDade, Olivia & Pirsch, 2002). Such factors as bureaucracy, slow information sharing and decision-making have been shown to negatively impact the ability for Idea Driving and Market Learning (Dougherty & Heller, 1994; Kanter, 1988; Simon, 1945). Therefore, while larger firms have access to greater Resource Availability, which should positively impact the relationship between Market Visioning Competence and Market Vision, the impact of large-firm bureaucracy can levy a strong counterbalance by hindering the movement of information and ideas internally from individuals to the organization (Burgelman & Sayles, 1986).

Firm Size and Resource Availability, therefore, may have important moderating effects on the ability for firms to be successful in the case of radical innovations. In this thesis research, therefore, they will be considered as contextual variables affecting the ability of a firm to move from Market Visioning Competence to Market Vision.

> **Hypothesis (H7):** Larger Firm Size, through its internal bureaucracy, will have a negative impact on the relationship between Market Visioning Competence and Market Vision.

Hypothesis (H8): Higher levels of Resource Availability will have a positive impact on the relationship between Market Visioning Competence and Market Vision.

3.5.2 Moderators of the Market Vision to Early Performance Path (Supply Side of Diffusion)

Robertson and Gatignon (1986) (also see Gatignon & Robertson, 1986) have developed a set of propositions regarding the effects of technology and competition on the rate of diffusion on the supply-side of the diffusion process (i.e., factors that impact diffusion of technology-in-product to the marketplace). From their research, we see that important moderators of the diffusion of technology embodied in products to the market include *technology factors* (i.e., Appropriability), *competitive factors* (i.e., Industry Concentration, Incumbency and Reputation).

3.5.2.1 Technology Factors. One technology factor is *Appropriability*, the attributes of the innovation that allow the firm to capture the profits of innovative activity (Teece, 1988; Winter, 2000). Appropriability may be achieved through patenting, use of trade secrets or standardization (Winter, 2000) and impacts Early Performance through protection and by giving a firm a longer period of time over which to develop and capitalize on new technologies (Teece, 1988). Appropriability is therefore hypothesized to impact the relationship between Market Vision and Early Performance by protecting the ideas embodied in Market Vision for as long as possible from competitors.

Hypothesis (H9): The effectiveness of Market Vision, in terms of impact on Early Performance, increases with appropriability.

3.5.2.2 Competitive Factors. One competitive factor is *Industry Concentration*, which reflects the number of firms operating in an industry (Robinson, 1988). Higher Industry

Concentration means that there are fewer competitors engaged in pursuing similar ideas. Higher Industry Concentration is usually related to more mature industries. On the other hand, lower Industry Concentration, indicates an emergent young industry, with many players where fall-out has not yet occurred (Levitt, 1965). This is the most common scenario in the early stages of radical innovation as witnessed in the early days of the computer industry, the internet, biotechnology and now, with nanotechnology. When there are more players in the marketplace and, therefore, Industry Concentration is lower, awareness of a new radical innovation is likely to build more quickly and dominant designs (Abernathy & Utterback, 1978), based on higher levels of competition, will emerge more quickly (D'Aveni, 1994). As such, the effectiveness of Market Vision's impact on Early Performance increases with lower Industry Concentration. Therefore, Industry Concentration is hypothesized to moderate the relationship between Market Vision and Early Performance.

> **Hypothesis (H10):** The effectiveness of Market Vision, in terms of impact on Early Performance, increases with lower Industry Concentration.

Another competitive factor, *Incumbency,* reflects the proportion of firms participating in the new technology that also participated in the previous technology it substitutes for (Gilbert, 1989). Higher levels of competition from incumbents raise the stakes (D'Aveni, 1994) and the level of competition for finite resources, such as a small talent pool or, possibly, access to channels of distribution and suppliers. This competition, however, is good for radical innovation in that it tends to move things forward at a more rapid clip as firms attempt to secure the resources required to enact their Market Vision (Hunt & Morgan, 1996). Therefore, level of Incumbency is hypothesized to moderate the relationship between Market Vision and Early Performance.

Hypothesis (H11): The effectiveness of Market Vision, in terms of impact on Early Performance, increases with higher levels of Incumbency.

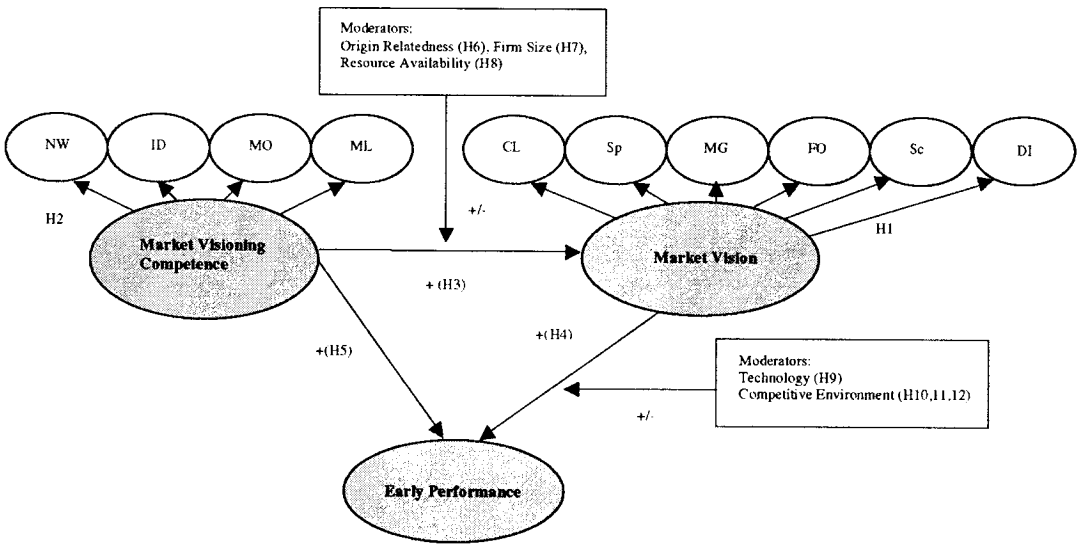
A final competitive factor which will be tested in this thesis is *Reputation*. High positive levels of Reputation, related to market perceptions regarding new product providers and their positive influence on future profitability, should not only speed up diffusion due to lending credibility to radical new products and services, but should also increase the chances of having a good outcome in the marketplace, based on goodwill and trust (Kramer & Tyler, 1996; Murphy, 2002; Robertson & Gatignon, 1986). Reputation is considered to have an impact on the relationship between Market Vision and Early Performance because it improves the way the target market views an idea. For example, firm Reputation might impact a Market Vision by lending it credibility in the marketplace through the halo effect (Thorndike, 1920). In other words, the potential market might begin to develop a positive association of a radical technical idea associated with a firm with a good Reputation, even prior to product development. For example, HP is currently involved in the development of several nanotechnology ideas into products none of which have yet been realized. Still, one senses in the popular literature (for example, several articles published in the last couple of years in MIT Technology Review), that the market anticipation of what will ultimately be delivered by HP is high and positive. As such, Reputation is hypothesized to have an important moderating impact on the relationship between Market Vision and Early Performance.

Hypothesis (H12): The effectiveness of Market Vision, in terms of impact on Early Performance, increases with higher levels of Reputation.

3.6 Conceptual Model: Structural, Causal and Moderating Hypotheses

The model which will be tested in this dissertation is presented in Figure 7. Underlying this model are four fundamental tenets and several secondary hypotheses. These are

discussed and summarized in Table 4. The first two fundamental tenets involve the structural relationships between the first order and second order factors, which comprise: (1) Market Vision and (2) Market Visioning Competence (H1, H2). The third fundamental tenet is derived from research supporting the causal hypothesis that Marketing Visioning Competence helps the development of Market Vision (H3). The fourth fundamental tenet involves the causal relationships of both Market Visioning Competence and Market Vision with Early Performance (H4, H5). Secondary hypotheses in this research relate to the variables which are seen as moderating the extent to which Market Visioning Competence results in a strong Market Vision (H6, H7, H8) and those which moderate the impact of Market Vision on delivering Early Performance (H9, H10, H11, H12).



Legend:

NW = Networking
ID = Idea Driving
MO = Proactive Market Orientation
ML = Market Learning Tools

CL = Market Vision Clarity
Sp = Market Vision Support
MG = Market Vision Magnetism
FO = Market Vision Form
Sc = Market Vision Scope
DI = Market Vision Discontinuity

Figure 7. Conceptual Model of Impact of Market Visioning Competence and Market Vision on Early Performance with Moderating Variables

Table 4
Summary of Hypotheses

Main Construct(s)	Main Effects of General Model	Impact on Path between MVC and MV	Impact on Path between MV and EP
H1 Market Vision (MV)	Second Order	n/a	n/a
H2 Market Visioning Competence (MVC)	Second Order	n/a	n/a
H3 MVC→MV	+	n/a	n/a
H4 MV→EP	+	n/a	n/a
H5 MVC→EP	+	n/a	n/a
H6 High Origin Relatedness	n/a	+	n/a
H7 Firm Size	n/a	-	n/a
H8 Resource Availability	n/a	+	n/a
H9 Appropriability	n/a	n/a	+
H10 Low Industry Concentration	n/a	n/a	+
H11 Level of Incumbency	n/a	n/a	+
H12 Level of Reputation	n/a	n/a	+

3.7 Variables/Factors which will not be Tested

While it is important to propose how the various levels of vision (i.e., technology, product-market, project, organizational) are likely to be linked in the context of radical innovation, this research focuses on the most underdeveloped level in vision scholarship, the product-market level. In other words, concepts that have already received substantial attention in the literature and/or that are not directly related to Market Vision in the discontinuous innovation context—the topic of this thesis—will not be covered. These are briefly described below.

3.7.1 Vision Stability

As described above, vision stability—that is, the ability for a vision to remain consistent over time—was found by Lynn and Akgün (2001) to not have a significant relationship with the success of project visions involving radical innovations. This makes sense

because, in the case of new-to-the-world ideas involving advanced technologies, vision is not likely to remain stable over time. Instead, it is likely to become more enhanced as it develops in the emergent case of radical innovations (Collins & Porras, 1995). Further, since Project Vision is proposed to occur after Market Vision in the emergent case, Project Vision should be more stable and elaborate than Market Vision. Divergence in visioning (Colarelli O'Connor, 1998), leading to the development of Market Vision, suggests that in the early stages of vision formation, stability would be highly unlikely. It is proposed in this research that development with "patsy markets" and experience with more than one market in the development of prototypes is likely to improve Market Visioning Competence and the resultant Market Vision (Lynn, 1996), however this means that stability of Market Vision would actually not be desirable or likely. Finally, in order to truly test stability, a longitudinal study is needed to develop a more accurate assessment of the extent to which vision remains consistent over time and how this might impact Early Performance. Given these arguments, vision stability will not be tested in this dissertation. It is not considered to be a key component of Market Vision for discontinuous innovations, and it is considered inappropriate for testing in a cross-sectional study such as the one presented in this thesis.

3.7.2 Market Driving Strategies

Market Vision is proposed to be a mental model or image that stems from Market Visioning Competence with this image serving as input to later strategic paths. Project Vision is proposed in this research to provide a link between Market Visioning Competence/Market Vision and the specific action steps of project strategy. These action steps that occur during the project stage are considered to be part of "market driving strategies" (Kumar, Scheer & Kotler, 2000). Thus, market driving strategies will not be considered in this dissertation because they occur after Market Vision has been established and are more closely related to Project Vision.

3.7.3 Incremental Innovations

Given the proposed components of Market Vision, it is possible to see that this construct could also be developed in the context of incremental or continuous innovations. In these cases, however, the process by which a Market Vision is enacted is likely to be different from the radical case. The marketing visioning process would be much faster and more of a top-down process, as discussed in the literature review. Also, in the case of incremental/continuous innovations, the company is likely to be operating in a more advanced stage of the technology life cycle where market segments have already been established. This means that, not only is the Market Vision Form likely to be converging between companies (and therefore is not likely to lead to advantage), but the competitive environment is also probably more evolved and, therefore, is likely to have a negative impact on the ability of Market Vision to impact Early Performance.

3.7.4 Other Potential Moderating Relationships

Three factors have been identified which, while likely to moderate the relationship between Market Vision and Early Performance at the supply side of the diffusion process, would prove difficult to test under the circumstances of this dissertation. These include the following firm-level factors: *Marketing Expenditures*, *R&D Expenditures*, and *Order of Entry*. Marketing Expenditures (Dutta, Narasimhan & Rajiv, 1999) and R&D Expenditures (Cohen, Levin & Mowery, 1987; Jeffe, 1986) have been studied extensively and have been shown to impact firm Early Performance in the case of high-technology. With regard to Marketing Expenditures, Dutta, Narashimhan & Rajiv (1999) found a direct relationship between marketing spending and market outcomes in high-technology markets. As such, market spending can also be seen as potentially impacting the relationship between Market Vision and Early Performance by better enabling some of the early market tasks like product testing. With regard to R&D Expenditures, Ettlie (2000)

states that for the average company, spending on R&D is the key resource allocation that determines whether innovative products will do well in the market. In essence, the decision to spend more R&D money on developing the product component of vision (i.e., part of Market Vision Form) appropriately has a greater chance of success in the product-market interface that occurs in the marketplace. While R&D and Marketing Expenditures are expected to moderate the link between Market Vision and Early Performance, difficulties in collecting data of this nature, particularly from private companies, prohibit their inclusion. Unlike the past studies mentioned above, which gained information from public companies, the vast majority of companies surveyed for this dissertation are private companies. As such, they would likely be secretive and not answer questions of this nature since the questions related to an important strategic aspect of their business.

A final potential moderating factor of the relationship between Market Vision and Early Performance, Order of Entry in the marketplace, has been a subject of interest in marketing and innovation research during the last several years. However, studies have shown equivocal results regarding the impact of order of entry of firms on success with radical innovation. While some studies show market share rewards to pioneers (e.g., Urban, Carter, Gaskin & Mucha, 1986), others have found that fast followers tend to perform better (e.g., Tellis & Golder, 1996). This finding regarding fast followers is true especially when risks are high, as is the case with radical innovation. In cases where pioneers dominate, this tends to occur when the pioneer is an incumbent and the technology is competence-enhancing. Under different scenarios, such as unexpected success with prototypes, whims of early developers, political circumstances, or managing to lock into the mass market vision (Tellis & Golder, 1996), "fast followers" may be able to achieve sufficient penetration in the marketplace to dominate pioneers. Given these equivocal results and given that the overall impact of Order of Entry is itself likely to be moderated by several other factors (which are as yet unresolved in this literature), Order of Entry will not be included as a potential moderator in this study.

Chapter 4: The Measurement Study

According to Bollen (1989), the key goals of a measurement study are (1) to give meaning (specification of a domain) and identify dimensions and latent variables (each dimension represented by one latent variable); to form measures through (2) item generation and (3) item purification, guided by theory; and (4) to specify each measurement model (the relation between indicators or items for each latent variable). Further, two critical components of measures are their validity and reliability and these also must be tested in a measurement study (Bollen, 1989). The components of the measurement study facilitate the creation and testing of three of the four main models, in this dissertation (that is, three measurement models for each of the three constructs of interest). The fourth model is the structural model, which is developed and tested in Chapter 5.

The methodology of this dissertation, in the main, was designed to evaluate both the domain and underlying properties or dimensions suggested by the literature review, as well as the relevance—in terms of impact on Early Performance—of Market Vision (MV) and of its proposed precursor, Market Visioning Competence (MVC). In keeping with these goals, development of the Market Vision scale (Hypothesis 1) and Market Visioning Competence scale (Hypothesis 2) was conducted according to the scale development methodology proposed by Churchill (1979) and De Vellis (1991). A uni-dimensional scale of relevant items was also created to measure Early Performance ("EP"). The process for scale development for each of the three constructs of interest is outlined in Figure 8. This process involves specification of the domain and potential dimensions, item generation, purification of the item pool using exploratory factor analysis (i.e., the development phase), content validation, confirmatory factor analysis, scale reliability and construct validation. Methodology, discussion and conclusions relating to the findings of the exploratory factor analyses ("EFA"s) and confirmatory factor analyses ("CFA"s), in conjunction with the findings of the reliability and validity analyses, for each of three measurement models are presented in this chapter.

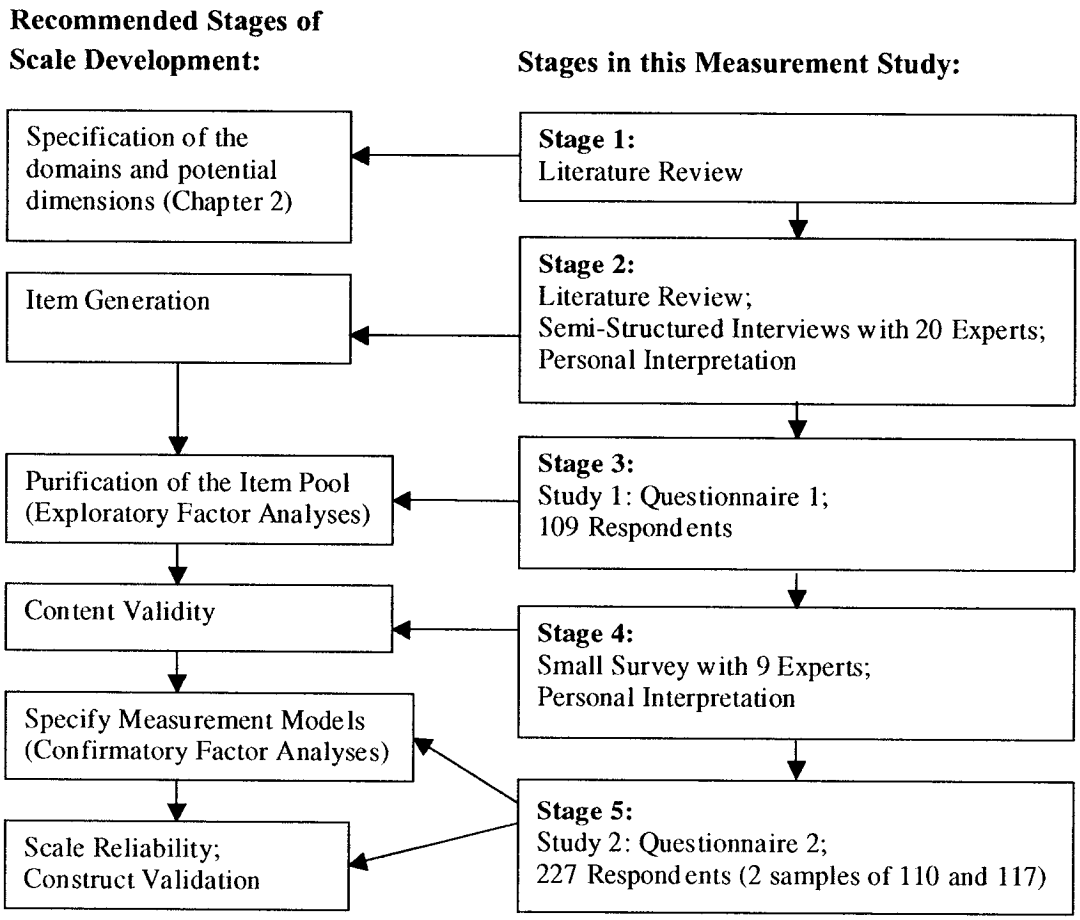


Figure 8. Methodology Outline for Scale Development

4.1 Specification of the Potential Domains and Dimensions of Each Construct

The first goal of the measurement study was to develop an understanding of the "domains" of the constructs in question: Market Vision, Market Visioning Competence, and Early Performance. "Domains" give meaning or definition to the universe that the construct pertains to. The specifications of the domains of MV, MVC and EP are presented in the Literature Review (Chapter 2). Both Market Vision and Market Visioning Competence are considered to be multi-dimensional constructs, for which potential dimensions, based on the literature, were specified in Tables 1 and 2 in Chapter 2 (the second goal of the measurement study). Early Performance is considered to be a uni-

dimensional construct and potential items comprising the one dimension were discussed in Chapter 2. Based on the literature review, which was assimilated from marketing, economics and management literatures, Market Vision is conceptualized as potentially subsuming six dimensions (MV Form, MV Scope, MV Clarity, MV Support, MV Magnetism, and MV Discontinuity); Market Visioning Competence four potential dimensions (Networking, Idea Driving, Proactive Market Orientation and Market Learning Tools); and Early Performance, one dimension.

4.2 Item Generation (Stages 1 and 2)

Churchill (1979) recommends the use of multi-item measures in order to improve reliability and better distinguish between the underlying components of a construct. As such, multiple items were created for the scale development involving the six potential components of Market Vision and the four potential components of Market Visioning Competence. In order to construct these items, an extensive literature review (Chapter 2) was undertaken and then, a first round (of two) of interviews with 20 experts was conducted.

The first stage of the measurement study, therefore, involved the generation of items based on the literature. To begin, items from previously existing scales that were considered potentially related to the constructs in question were modified and developed into new items (see Tables 5, 6 and 7). These included for Market Vision, MV Clarity and MV Support, which were reconstructed from Project Vision Clarity and Project Vision Support (Lynn & Akgün, 2001); and for Market Visioning Competence, Proactive Market Orientation (Narver, Slater & MacLaughlin, 2000) and Idea Driving items, which were borrowed from the championing scale of Howell and Shea (2001). Other concepts considered potentially relevant to the measurement of Market Vision, Market Visioning Competence and Early Performance were operationalized from the literature. This approach is consistent with the domain sampling methodology suggested by Nunnally (1967) and Churchill (1979) to create

a subset of items from the original domain in order to give an accurate estimate of the theoretical constructs of interest. In this approach, the measure should contain minimum variance while still accurately representing the construct (Reinecke Flynn & Pearcy, 2001). This process resulted in the generation of "first lists" of items to measure the three construct domains: Market Vision, 40 items (see Table 5), Market Visioning Competence, 58 items (see Table 6), and Early Performance, 6 items (see Table 7).

Table 5
Market Vision: Initial List of Measurement Items

Market Vision Form

1. The vision was very tangible.
2. The magnitude of the vision was quite great.
3. Our major concern was going after the biggest possible market.
4. We envisioned being first to market.
5. The product use was an important part of the vision.
6. We imagined how our customers would ultimately use the product, before it was even developed.
7. We imagined how the product would fit into an overall system of use for the end-user.
8. We imagined the product, but not necessarily how the product would be used.
9. Our image of the product was highly tangible.
10. We focused all of our energies on making our desired product for our desired market.

Preamble for Q.11 to 14: When we first started thinking about a specific market to develop for the technology, we spent most of our time thinking and talking about:

11. ...(estimate percentage)... the technology itself.
12. ...(estimate percentage)... the product's features and benefits.
13. ...(estimate percentage)... the product's design (components and integration).
14. ...(estimate percentage)... how the end-user would ultimately interact with and use the product.

Market Vision Scope

Preamble: When we first started thinking about a specific market to develop for the technology, we spent most of our time thinking and talking about:

1. ...(estimate percentage) the nature of the target market – size.
2. ...(estimate percentage) the nature of the target market – type.

Market Vision Magnetism

1. People were strongly attracted to this market vision for the project.
2. People inherently believed in the market vision for the project.
3. People identified with the market vision for the project.
4. The vision was considered to be very important.
5. The vision was considered to be very desirable.
6. The vision represented the values of the organization.
7. The vision became the guiding philosophy of the overall organization.

Continued on next page

Table 5

Market Vision: Initial List of Measurement Items (continued)

Market Vision Discontinuity

1. This vision of how the technology would play out in the market was very new compared to what was already available to the market for the same use.
2. This vision of how the technology would play out in the market was very different from what was already available to the market for the same use.
3. This vision was very different to other competing visions for the new technology.
4. We knew that this vision was so different that it would require a great effort to bring it to market.
5. We considered the technology risk to be very high.
6. We considered the market risk to be very high.
7. We were slow to adopt the technology because it was very complex.
8. We were slow to adopt the technology because it was very risky.
9. We were slow to adopt the technology because it was difficult to observe and understand.
10. We were slow to adopt the technology because it was difficult to try on a limited basis.

Market Vision Clarity

1. People involved in the early days had a clear vision of the required product features.
2. People involved in the early stages had a clear vision of the target market (user).
3. People involved in the early stages had a clear understanding of target customers' needs, and wants.
4. The technical goals were clear.

Market Vision Support

1. Overall, most senior company executives supported the market vision of this project.
2. Overall, team members supported the market vision of this project.
3. Overall, team managers supported the market vision of this project.

Table 6

Market Visioning Competence: Initial List of Measurement Items

Networking

1. The network of the initial champion of this vision seemed to be quite dispersed.
2. The network of the initial champion of this vision seemed to be made up of people with quite different backgrounds and experiences.
3. The network of the initial champion of this vision seemed to be quite large.
4. We interact regularly with external financiers, like venture capitalists or bankers.
5. We interact regularly with government officials.
6. We actively utilize the government resources at our disposal.
7. We are involved with "alliances" with other companies.
8. We routinely interact with our customers, particularly those that seem to be at the forefront of new developments, to develop our own ideas.
9. We routinely interact with our suppliers, particularly those that seem to be at the forefront of new developments, to develop our own ideas.
10. We actively recruit people with skills that will support involvement with important new radical technology opportunities.
11. It is important that we are at the forefront of new developments by being the first amongst those involved with a new technology.
12. It is important for us to be at the nucleus of any new group forming around the development of a new technology.
13. We were able to ID lead users ahead of the competition.

Continued on next page

Table 6

Market Visioning Competence: Initial List of Measurement Items (continued)

Idea Driving

1. We had a technical advisory/steering committee during the development of this technology.
2. The person who championed the new technology got key decision makers involved.
3. The person who championed the new technology secured the top-level support required.
4. The person who championed the new technology got problems into the hands of those who could solve them.
5. The person who championed the new technology got the right people involved in the innovation.
6. The person who championed the new technology made improvements based on feedback received.
7. Support was gained for the radical new technology by active campaigning on the part of the champion with top management.
8. Support was gained for the radical new technology by active campaigning on the part of the champion with team members.
9. Support was gained for the radical new technology by validating the vision with suppliers.
10. Support was gained for the radical new technology by validating the vision with users.
11. Support was gained for the radical new technology by validating the vision with alliance partners.
12. Support was gained for the radical new technology by validating the vision with external financiers.
13. Support was gained for the radical new technology by validating the vision with government contacts.
14. We often co-develop new products with our customers or suppliers; we find it useful in gaining internal support to move things along.
15. When an important new radical technology opportunity comes along we move quickly to assess whether we need to change our "strategic envelope" in order to accommodate such an opportunity, where necessary.
16. We try to see how the products we are thinking of developing might be part of a larger system or infrastructure, so that we can plan these into our development, where possible.
17. It appears that the key person who got us involved with this technology shared information and ideas very quickly with senior management – they didn't sit on their ideas too long.
18. Customer contact employees are willing/able to feed market information to management.
19. R&D employees are willing/able to feed market information to management.
20. Information regarding new potential technologies/marketing options is quickly and widely spread throughout the organization.

Proactive Market Orientation (A proactive market orientation is one where the organization attempt to understand and satisfy customers' latent needs, Narver, Slater and MacLachlan 2000).

1. We help our customers anticipate developments in their markets.
2. We continuously try to discover additional needs of our customers of which they are unaware.
3. We incorporate solutions to unarticulated customer needs in our new products and services.
4. We brainstorm on how customers use our products and services.
5. We innovate even at the risk of making our own products obsolete.
6. We search for opportunities in areas where customers have a difficult time expressing their needs.
7. We work closely with lead users who try to recognize customer needs months or even years before the majority of the market may recognize them.
8. We extrapolate key trends to gain insight into what users in a current market will need in the future.

Continued on next page

Table 6

Market Visioning Competence: Initial List of Measurement Items (continued)

Market Learning Tools

1. We try to follow several potential technology/marketing options, for as long as possible before committing to one option.
2. We usually use a couple of small, known, niche markets to better develop and learn about a radical new technology, before going after a mass market.
3. We find that co-developing products for new technologies helps better anticipate the needs of future markets.
4. We get involved with more than one market when developing radical new technologies.
5. We search for opportunities where markets are not large, but we believe have the potential to be.
6. We actively seek to develop new markets.
7. We go back to potential customers as quickly as possible with new prototypes, even at the expense of them not being perfect or making mistakes.
8. We seek to interact with multiple lead users to gain as much experience as possible with what their future needs might be with radical new technologies.
9. We seek to interact with lead suppliers to gain as much experience as possible with what their future needs might be with radical new technologies.
10. We use forecasting tools to learn about potential markets. (List if known)
11. We use tools to help us think about the future.
12. We try to develop several potential outcomes or scenarios that might occur with a given technology and then use this to choose which markets to pursue.
13. We try to use a combination of forecasting techniques to maximize our chances of choosing the right market application.
14. Our organization is interested in the potential for new information regarding new technologies to contribute to the future.
15. Our organization is really myopic when it comes to new visions of the future.
16. We have a "memory mechanism" at work in our organization to capture lessons learned about past innovations, both good and bad.
17. We use a decision support system to help track market opportunities.

Table 7

Early Performance: Initial List of Measurement Items

Early Performance

1. Products stemming from the technology provide a competitive advantage (e.g. profits).
2. Customers were satisfied.
3. Customers accepted the products stemming from the technology (even prior to sales).
4. External sources of private financing were attracted to the project (e.g., venture capital).
5. External sources of public financing were attracted to the project (e.g., public stock issue).
6. The patent has been cited as compared to other industry patents.

The second stage of item generation was based on qualitative semi-structured interviews with 20 experts and on personal interpretations (Richins & Dawson, 1992; Bearden *et al.*, 2001). Utilizing this additional information, the initial list of items was

complemented and revised through the addition of new items, the refinement and rewording of some items and, the removal of other items. This enhanced list of items constituted the pool of items used for measuring Market Vision, Market Visioning Competence and Early Performance in the measurement study: 40 items to measure Market Vision, 61 items to measure Market Visioning Competence, and six (6) items to measure Early Performance. For Market Vision and Market Visioning Competence items, a stage-setting statement was developed to the effect of "Think back to how people felt before this project was given the green light for formal development." For Early Performance items, the preamble was as follows: "Please indicate the degree of success, which you feel your company has achieved along each of the following indicators (1 = 0% success; 7 = 100%)".

In addition to these 107 items to measure the three constructs of interest, a further 19 items were required to examine potential moderation effects in the structural model (see discussion based on the literature in Chapter 3, sections 3.5 and 3.6). Also, five (5) manipulation check questions and eight (8) demographic questions were utilized for classification purposes. The manipulation check questions were used to verify that the respondents met the requirements for participation in the study (i.e., to verify that the innovations were radical and the companies were high-tech). The demographic classification questions allowed for some testing of potential variance among types of respondents. In total, 139 items were used in the administration of Questionnaire 1 (see Appendix 1).

4.3 Purification of the Item Pool (Stage 3)

The purpose of Stage 3 was to purify the measurement instrument based on the psychometric properties of each of the scales being developed, in order to satisfy the third goal of the measurement study. To this end, the first questionnaire was administered. This stage was used to check the items contained in the instrument so that only the best items, according to established statistical tests were retained and utilized in the scales for the next steps, Stages 4 and 5 (Churchill, 1979). While the focus for

scale development was parsimony, in addition to meeting all the measurement criteria, only those items that were meaningful to respondents and shown to be statistically valid and reliable were maintained.

The original pool of 139 items was included in the first questionnaire and administered to the first sample of respondents. Most of the items (116) were formatted into 7-point Likert-type response scales, where 1 = "totally disagree" and 7 = "totally agree". Additionally, several (13) of the items used 7-point Likert-type scales, but had different labels identifying the extreme ends of the spectrums, which were specifically relevant to the questions being asked. For example, in one case, 1 = 0 firms and 7 = 100% of firms, was the response scale. In the case of the manipulation-check and demographic classification questions, seven (7) were of the fill-in-the-blank variety and three (3) were dichotomous Yes/No questions. During the item generation and instrument development phases, lengthy, ambiguous or multi-dimensional statements were removed from the item pool (Bearden *et al.*, 2001; De Vellis, 1991).

4.3.1 Sampling Population

A broad range of high-tech industries were surveyed with the first questionnaire including pharmaceuticals, biotechnology, materials, chemicals, electronics (computers, semiconductors, MEMS), defense and aerospace (Stage 3, Study 1). These industries provided a strong sampling population due to the following factors: stalwart research intensity with a high R&D as % of sales (therefore likely to meet or exceed the high-tech criterion), a strong tendency toward attempting to solve "breakthrough" scenarios (therefore likely to meet or exceed the radical criterion), and a large potential sampling population. For Canadian companies, the "Strategis" website was used in conjunction with the internet to come up with a potential pool of candidates to contact. Additionally, a list of Canadian high-tech manufacturing companies was provided from a previous new product development study (carried out at the John Molson School of Business, Concordia

University and McMaster University) for potential contacts. Finally, the CME (Canadian Microelectronics Association) and MANCEF (Microelectronics and Nanotechnologies Commercialization Education Fund) provided access to European and U.S. companies, through databases of their member organizations and contacts.

4.3.2 Sample: Inclusion of High-Technology Firms involved with Radical Innovation

As mentioned in the first three chapters of this dissertation, the scenario where Market Vision and Market Visioning Competence are most relevant is with radical innovation. In order to maximize the chances of locating companies that would be representative of this situation, therefore, it was considered important that respondents represent firms that are involved with the commercial development of an advanced technology considered "high-tech" and "radical".

The term "technology" refers to the "theoretical and practical knowledge, skills, and artifacts that can be used to develop products and services as well as their production and delivery systems. Technology can be embodied in people, materials, cognitive and physical processes, plants, equipment, and tools" (Burgelman, Maidique & Wheelwright, 1996, p. 2). Bolland and Hofer (1998) specifically define "high-technology business" as "an activity and/or an organization that seeks to provide products and services that incorporate advanced technologies or are created through technologically intensive processes" (pg. 22). Three groups have been classified by Riche, Hecker and Burgan (1983):

> Group 1. Industries that employ a proportion of technology-oriented workers greater than 1.5 times the average for all industries or 5.1% of total employment;
>
> Group 2. Industries that display ratios of R&D expenditures to sales greater than twice the average for all industries, or a minimum of 6.2%;

Group 3. Industries that satisfy criteria concerning both the relative R&D expenditure and the proportion of technology-oriented workers. The proportion of technology-oriented workers had to be greater than the average for all manufacturing industries (6.3%) and the R&D to sales ratio had to be close to or above the average for all industries (3.1%)

In order to ensure that the firms included in the sample were considered "high-tech", as defined above, a question was included that asked: what percent (%) of sales (or % of worth, for new organizations) is spent on R&D. In keeping with the second group above, those who stated that their % sales spent on R&D was greater or equal to 6% were maintained for further analysis (Riche, Hecker & Burgan, 1983). Firms not meeting this criterion were eliminated from further analysis.

Operationally, Colarelli O'Connor and Veryzer (2001) suggest that a radical innovation project must be viewed by the firm as having the potential to offer unprecedented performance features or embodying familiar features that offer the potential for 5-to-10-fold improvements in performance or at least a 30% reduction in cost. This criterion was mentioned to potential respondents during the initial contact phone call and in the e-mail accompanying the questionnaire. Finally, manipulation checks were also included within the questionnaire, as a further verification of the newness of the innovation in terms of both the technology and the market infrastructures (that is: "The technology required to develop this product (R&D) was totally new to our company"; "The manufacturing process used was totally new to our company"; and, "The product needed (will need) to be sold through unfamiliar channels of distribution"). In order to be included in the analysis for the exploratory factor analysis, respondents had to score at least a 5 on the 7-point scale for one of the first two above-mentioned items. In other words, either the technology or the manufacturing process had to be considered totally new. Additionally, those respondents whose combined average for the above-mentioned items was less than four were eliminated. These proxies for market newness

and technology newness helped to ensure that truly radical innovations were the focus of the research. Definitions for "high-tech" and "radical" were also included on the first page of the questionnaire, so that individuals could use these to self-select their organizations, based on the definitions provided, prior to commencing the questionnaire.

4.3.3 Sample 1: Survey Procedure

Initial phone calls and/or e-mails were sent to CTOs, CEOs and Directors of R&D for firms involved in the industries of interest, as outlined in the previous section. Sampling was based on a judgment sample, and was stratified and non-proportional, in order to increase efficiency of the sampling process across incumbent establishments and senior managers (Easterby-Smith, Thorpe & Lowe, 1991). The general aim was to reach CTOs, CEOs and Directors of R&D, as these individuals were typically available for both small and large organizations. With small organizations, the person who worked directly with the technology was often the CTO or CEO. For large organizations, CTOs or CEOs would respond if they felt familiar with the development of the technology, but in other cases would forward the survey to a project leader, manager, team member or other individual who was close to the development of the technology and therefore would be in a better position to answer the survey. The cover e-mail and first page of the questionnaire were designed to encourage this. The results indicate that: 54.1% (59) of respondents were both senior managers and also active members of the team involved in developing the technology; 15.6% (17) were only on the development team; and 21.1% (23) were only senior managers. A small percentage, 9.2% (10) of respondents, were neither senior managers nor team members, but instead were either on the board of directors or a major investor (i.e., venture capitalist) who was close to the development of the technology.

The initial phone call and/or e-mail to potential respondents provided a brief explanation of the scope of the research as well as the dissertation's importance. The questionnaires were then sent to the potential respondents via e-mail. Generally speaking,

two follow-up phone calls or e-mails were made/sent after two weeks when no response had been received. Support from various organizations, including the PDMA (Product Development and Management Association), CATA (Canadian Advanced Technology Alliance) and CMC (Canadian Microelectronics Corporation) were mentioned. Additionally, a summary report and a top 20% performer report of the study were offered as benefits of participation. All participants were guaranteed both individual and company confidentiality and that their data would be presented/published only in a pooled manner. Survey response for the first questionnaire was by fax, e-mail and regular mail. The survey collection for the first questionnaire took approximately six months.

4.3.4 Sample 1: Size Issues

Sample sizes between 100 and 200 respondents are considered best in the construct development phase for exploratory factor analysis (Churchill, 1979), since sample sizes may be an issue for factor analyses if too low or too high. Instability in factor structure, inability to reveal the underlying factor structure, or inflated reliability are all consequences of insufficient or inflated sample sizes (Reinecke, Flynn and Pearcy, 2001). The first sample used in this dissertation for the development phase of the measurement study (Stage 3) included 109 respondents, of the nature described above. A total of 441 initial contacts were made; 288 of these either did not participate or were unable to participate due to time constraints, company policy or for other unknown reasons. A further 19 non-respondents considered their company's technology involvement as not high-tech or radical enough to participate, based on the definitions provided. Another 12 contacts, while meeting both radical and high-tech criteria, were simply at a stage that was too early in the NPD process to respond (i.e. they were more at the technology visioning stage rather than at the market visioning stage). The remaining 122 respondents completed the survey, providing a response rate of 28%. Of this sample, 13 were eliminated based on responses to the manipulation checks. This provided a total of 109 surveys, which were considered to be of sufficient quality for analysis.

4.3.5 Exploratory Factor Analyses: Preliminary Statistics

The purification step for the scale development was performed using the data from Questionnaire 1 (Appendix 1) and was carried out to allow for the removal of items with poor psychometric properties. Following methods suggested by Bearden *et al.* (2001), Bollen and Lennox (1991) and Devellis (1991), analyses were performed utilizing both SPSS (Versions 11.5 and 12) and EQS (Version 6.1). These analyses facilitated the exploratory factor analyses.

In order to perform these analyses, the first step in the EFAs was to calculate the correlation matrix for each of the three constructs of interest. From the initial correlation matrices, three sets of statistics were available for each of the three constructs, as follows: the determinants of the correlation matrices, the Kaiser-Meyer-Olkin (KMO) measures of sampling adequacy, and the Bartlett Tests of Sphericity.

The determinant of the correlation matrix is an overall measure of correlation. This value should be greater than zero, in order for R to be "positive definite" (Bollen and Lennox 1991). Matrices which have a determinant of zero are considered "singular" and are not possible to analyze further because the computation of matrix properties is not possible. For the data collected in response to Questionnaire 1, for all three constructs, the determinants of the correlation matrices are positive definite, or greater than zero and, therefore, can be assessed.

The 'KMO' is an index for comparing the magnitude of the observed correlation coefficients (r) to the magnitude of the partial correlation coefficients. Small values for the KMO measure indicate that a factor analysis of the variables may not be a good idea, since correlations between pairs of variables cannot be explained by other variables. The values of 0.770 (MV), 0.716 (MVC) and 0.680 (EP) calculated for these data would be classified by Kaiser (1974) as "good" and therefore acceptable for factor analysis.

The Bartlett test of Sphericity can be used to test the hypothesis that the matrix is an identity matrix. In Bartlett's test, the determinant of the matrix is converted to a chi-

square statistic and tested for significance. The null hypothesis is that the intercorrelation matrix comes from a population in which the variables are noncollinear (i.e., an "identity matrix": where all diagonal terms are equal to 1 and all off-diagonal terms equal 0, so that the components are completely uncorrelated). When the matrix is very large and there is no associated significance, it is unlikely that the correlation matrix is an identity matrix. The values of 964.164 (0.000) for MV and 502.762 (0.000) for MVC are further indications that the correlations are high enough to merit continuing with the exploratory factor analyses. In the case of Early Performance, however, while not statistically significant, the value for the Bartlett test was 78.385, which is considered to be fairly low (Norussis, 1985). Although an EFA was run for Early Performance, using the data set from Study 1, the results were treated with caution. It was decided that more measurement items were needed and that another EFA would be performed in the second study (Stage 5) in order to develop a better measure of Early Performance.

4.3.6 Exploratory Factor Analyses: Factor Extraction and Oblimin Rotation

According to Bollen and Lennox (1991), only factors with eigenvalues greater than one should be included in the solution. Using this criterion for factor retention, the data suggested the following models: in the case of MV, a 5-factor model (which explained 72% of the variance in the data); in the case of MVC, a 4-factor model (which explained 70% of the variance in the data); and in the case of EP, a 2-factor model (explaining 67% of the variance). As mentioned previously, however, the results for Early Performance were treated with caution due to problems with the correlation matrix. Additionally, the chi-square statistic and associated significance shown for the Bartlett test (964.164; 0.000 and 502.762; 0.000) also indicate that the number of factors in the case of MV and MVC can be considered to be accurate.

The first factor extraction for each of the three constructs resulted in a component matrix of loadings that was not easily interpretable. According to Bollen and Lennox

(1991), most factors are correlated with many variables ("cross-loadings"), leading to an initial matrix that is indicative of statistical noise. Therefore, in order to identify factors that are substantively meaningful, in the sense that they represent sets of closely related variables, a 'rotation phase' is employed. Because for all three construct domains, low levels of correlation were evidenced by the component (factor) correlation matrices (with correlations between 0.05 and 0.3), the factors were considered not to be completely orthogonal. This makes sense, given the second-order factor structure theorized for both MV and MVC. In each case, therefore, an 'oblimin' rotation was utilized, whereby the axes were not maintained at right angles, in order to elicit the best possible interpretation.

4.3.7 Exploratory Factor Analyses: Interpretation of Market Vision and Market Visioning Competence Factors

Using the above-described oblimin rotation technique, along with the principal components method for estimation of factor loadings on each of MV, MVC and EP, a set of successive exploratory factor analyses were performed. Items not satisfying the 0.50 threshold for exploratory factor analysis or those with high loadings on multiple dimensions (i.e., "cross-loaders") were eliminated from the scale after each factor analysis until satisfying psychometric properties were achieved (Bearden *et al.*, 1989; Kline, 1998). Further, each item was evaluated for each dimension of the three constructs. Items with a corrected item-to-total correlation above 0.35 and inter-item correlations (correlations between items measuring the same construct) above 0.20 were retained (Bearden *et al.*, 2001; Tepper Tian *et al.*, 2001). Inter-item correlations higher than 0.5 were also used as a flag, as this may be an indication that items are overly redundant (Bentler & Chou, 1988). The pattern matrices which resulted are shown in Tables 8 and 9.

Table 8

Pattern Matrix for Market Vision (EFA)[a,b]

Factor Name	Items (Rotated Factor Matrix)	1	2	3	4	5
MV **Clarity** (χ = 0.924) Preamble: "In the very early stages of this technology's development..."	...it was clear how the product would be used.[d] (MVCLUSE)	.883				
	...it was clear who the target market (user) would be. (MVCLUSER)	.881				
	...the market vision was tangible. (e.g., easy to visualize). (MVTANG)	.871				
	...it was clear what target customers' needs would be. (MVCLNEED)	.850				
	...the market vision was clear. (MVCLEAR)	.771				
MV **Magnetism** (χ = 0.874) Preamble: "In the very early stages of this technology's development the market vision was..."	...desirable. (MVDESIRE)		.905			
	...attractive. (MVATTRAC)		.840			
	...thought to potentially have a great impact on the market. (MVIMPACT)		.757			
	...important (MVIMPORT)		.721			
	...felt to be of great importance to society (MVSOCIET)		.686			
MV **Discontinuity** (χ = 0.771) Preamble: "We were slow to adopt this technology because..."	...it had a high degree of uncertainty. (SLOUNCT)			.784		
	...it required the combination of more than one scientific area of expertise. (SLOCOMB)			.782		
	...it was difficult to understand. (SLOUND)			.762		
	...it was very complex. (SLOCMPLX)			.717		
MV **Form**[c] (χ = 0.676)	...how end-user would ultimately interact with and use the product (MVUSE)				.847	
	...how product would fit into an overall system of use for potential customers. (MVSYSTEM)				.817	
MV **Scope**[c] (χ = 0.823)	...what the most profitable target market would be. (MVPROFTM)					.866
	...what the largest target market would be. (MVLGETM)					.849
	...what the most important target market would be. (MVIMPTM)					.833

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

a. Rotation converged in 8 iterations.

b. Total of 72% of variance explained.

c. Preamble: "When we first started thinking about what specific markets would benefit from the technology, we spent most of our time thinking and talking about..."

d. Underlining provided in this table to help identify item labels.

Table 9

Pattern Matrix for Market Visioning Competence (EFA) [a,b]

Factor Name	Items (Rotated Factor Matrix)	1	2	3	4
MVC **Idea Driving** (χ = 0.852) Preamble: "The person who first championed this technology in our firm..."	...got key decision makers in our firm involved[c] (IDDMKS)	.948			
	...secured the required senior management-level support. (IDSRMGR)	.928			
	...shared information and campaigned for support very quickly with senior management. (IDSHRSM)	.680			
MVC **Networking** (χ = 0.753) Preamble: "The person who first championed this technology in our firm..."	...was at the center of the network growing up around the technology. (NWCENTRL)		.819		
	...had a broad network of relationships outside of our company. (NWBROAD)		.760		
	...had a network made up of people with a variety of different backgrounds. (NWVARIET)		.710		
	...played a central role in the industry development of the technology. (NWICENTR)		.699		
MVC **Market Learning Tools** (χ = 0.801)	We use forecasting and market estimation techniques before making a market selection. (MLBEFORE)			.923	
	We use several forecasting and market estimation techniques in combination before market selection. (MLCOMBO)			.896	
	We use a decision support system (e.g. a database) to help forecast market opportunities. (MLDSS)			.694	
MVC **Proactive Market Orientation** (χ = 0.810)	We continuously try to discover additional needs of our customers of which they are unaware. (MLADNEED)				.912
	We incorporate solutions to unarticulated customer needs in our new products and services. (MLUNART)				.822
	We brainstorm on how customers use our products and services. (MLBRAIN)				.774

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

a. Rotation converged in 6 iterations.

b. Total of 70% of variance explained.

c. Underlining provided in this table to help identify item labels.

The results of the EFAs for MV and MVC provide a clear, easy-to-interpret set of factors. Coefficient Cronbach alphas show internal consistency (reliability) of each dimension and are recorded in Tables 8 and 9 for MV and MVC, respectively. Each coefficient alpha respects the Nunnally (1978) criterion of 0.70 (these are provided as standardized α values). The only exception is the alpha coefficient for MV Form (α = 0.68). This result, however, is likely to be related to having only 2 items loading on the factor. In order to rectify this situation, one of the foci of the second round of expert interviews conducted (i.e., Stage 4) prior to the two data collections for the second study and prior to running the CFAs, was to gather additional items for inclusion in the MV Form factor.

Overall, the results suggested by the EFAs and internal consistency analyses support the domain structure which was proposed on the basis of the literature review. There is only one exception and this has to do with one of the proposed Market Vision dimensions, "Market Vision Support", which does not come out as a factor. One possible reason for this result may be that three different levels of potential supporters (senior company executives, team members and team managers) were incorporated by Lynn and Akgün (2001) in their support measure, which was adopted in this research. In other words, respondents may have answered positively for one level of support, but not for another. This was either because they could not identify whether support existed at other levels—very possibly due to lack of communication at such early stages of development of a technology—or, because there was some resistance at different levels to the technology or the Market Vision. Further, it is possible that support for a vision at this early stage is separate from the vision itself because support may come from external players (e.g., financiers, suppliers, customers). Related to this, support may be given for many things such as the idea, the technology and the people involved, and therefore it is not just specifically tied to the vision. Therefore, support is not part of the second-order construct of Market Vision.

It should also be noted that, in the correlation matrix, MV Discontinuity had small correlations with two Market Vision dimensions and had no correlation with two other Market Vision dimensions. This suggests that, while a factor per se, it is unlikely that MV Discontinuity is a part of the second-order Market Vision construct. This issue is dealt with more definitively in the confirmatory factor analyses provided later in this chapter.

4.3.8 Second Set of Expert Reviews and Content Validity (Stage 4)

Stage 4 of the measurement study entailed interviews with a second group of experts (9), which were utilized to evaluate the pool of items which had been tested in Questionnaire 1. Each expert received the pool of items and instructions about what each item purported to measure along with each dimension's definition. They reviewed the items that had been developed and were asked to judge the relevance and representativeness of each. The experts were also asked to evaluate clarity and completeness of the items.

This process helped in the rewording of ambiguous items, further refinement and reduction, and to generate new items which were felt to be missing. For example, in the cases of MV Form and the Early Performance factor, generation of potential new items was required and several suggestions were provided by the experts. Also, in each of these cases, an EFA was performed with the second data set to clarify that the new items should, in fact, be included in the CFAs. These results are discussed later in this chapter.

Finally, during the course of administering the first questionnaire (Stage 3), several respondents provided feedback, either verbally or written directly on the questionnaire. For example, in the case of the wording of the preamble for the MV Discontinuity items, several individuals mentioned that they would like to see the word "create" added to the preamble (e.g., so that the wording would be: "We were slow to adopt/create this technology because..."). The findings of this phase of the research were incorporated, where relevant, for use in the second questionnaire for the second study with two samples.

This second set of expert reviews also provided a content validity check for the scales (Bearden *et al.*, 1989).

4.4 Specification of the Measurement Models (Stage 5)

After the purification and content validity stages (Stages 3 and 4, Study 1), it was decided that it would be appropriate to advance to the next step, specification of the measurement models. The main goal of Stage 5 of the research was to discover the relationship between indicators or items comprising each latent factor. Confirmatory Factor Analysis allows the number of factors to be restricted to a specific number (usually based on the eigenvalues > 1 rule from the EFAs in the purification stage) and then specification of the particular patterns of relationships between measured items and selected factors may be performed (Fabrigar *et al.*, 1999). This facilitates performing preliminary confirmatory factor analyses and then further re-specifications in the final CFAs. Lastly, competing latent structures for MV and MVC are tested to determine the best model in each case. Also, validity and reliability are the final tests for the measurement study (Bollen, 1989).

4.4.1 The Second and Third Data Samples: Survey Procedures

The data collection for use in the measurement study should include two samples (samples 2 and 3) that are of similar size (Churchill, 1979). Sample 3, the second of the two data sets used for Study 5, was utilized to provide further evidence of reliability and to test the factor structure as a cross-validation against the other sample: sample 2 (Mosier, 1951). Herzberg (1969) and Mozier (1951) suggest that for this sample researchers should utilize a different data set collected from a different segment from with the same industry (in this case, from another segment of the nanotechnology sector). As such, while sample 2 consisted of a broad base of nanotechnology types mostly focused on nano-structures, nano-tools, nano-products and nano-systems, sample 3 was conducted specifically from companies developing advanced "nanomaterials".

The second sample of firms (Stage 5, Study/Questionnaire 2) used for this dissertation included 110 respondents, which were selected from the emerging nanotechnology sector. Companies and respondents were selected from a database that was created by compiling names from several sources including: the Canadian Nanobusiness Alliance, The American-based Nanobusiness Alliance, the "Small Times" Nanotechnology Directory, the USPTO and the internet. Respondents were first contacted by telephone or e-mail in order to solicit participation, with the conditions of participation ("high-tech" and "radical" according to the definitions already mentioned) explained and agreed to by respondents, up-front. Those respondents who agreed to participate and who considered themselves to be eligible, based on the same criteria as those utilized in Study 1, were directed to a web-based survey link. A total of 495 initial contacts were made, 180 of who responded to the survey (response rate: 36%). Many of the cases, however, were not complete (70) enough for inclusion, which led to a final second sample of 110 respondents (final response rate: 22%).

The third sample used in this dissertation comprised 117 respondents, specifically selected from the advanced materials sector. These firms were selected based on an assessment of the patents and/or products to be involved in the development of nanotechnologies, given their profile. Companies and respondents were selected from the "Fuel Cell", "Advanced Materials" and "The Materials Societies" directories. The same method of contact and response was utilized as with the second sample. A total of 539 initial contacts were made; 146 of which led to a response (response rate: 27%). Of these, 29 cases were not complete enough for inclusion, leading to a final sample of 117 (final response rate = 22%).

4.4.2 The Second and Third Samples: Size Issues

Item-to-respondent ratios for CFAs range from 1:4 to 1:10 in order to determine suitable sample sizes (DeVellis, 1991). The level of the ratio is related to issues of data normality.

Mardias tests on the data collected for this research indicate that both the second and third data sets are slightly kurtotic. They do not show signs of extreme kurtosis as significance was not indicated. A moderate response ratio of 1:6 to 1:7 is therefore considered adequate. According to the exploratory analyses, the construct with the largest number of items was the Market Vision construct with 17 items. Therefore, utilizing a 1:6 ratio, a minimum of 102 questionnaires was required to perform a confirmatory factor analysis for each scale. Other sources state that sample sizes between 100 and 300 are considered adequate for such an analysis (Reinecke Flynn & Pearcy, 2001); therefore final samples of 110 and 117 respondents were obtained for the second and third data sets, respectively. The second data set was first utilized to re-run EFAs on MV Form, MV Clarity and Early Performance, because each of these factors had new items added to it for measurement as a result of the expert interviews and further literature review/personal interpretation. The second and third datasets were used to carry out the CFAs for each of the three construct domains (i.e., MV, MVC and EP).

4.4.3 Re-Runs of Exploratory Factor Analyses: MV Form, MV Clarity and Early Performance

In the case of MV Form, which had only two items loading in the EFA in Stage 3, generation of potential new items was required and several suggestions were provided during the expert interviews. Prior to beginning the CFA for MV Form, an EFA was re-run on the MV Form factor using the second data set in order to see which additional new items loaded on it. For this re-run of the EFA with the MV Form factor, items not satisfying the 0.50 loading threshold or those with high loadings on multiple dimensions were eliminated from the factor (Bearden *et al.*, 1989; 2001). As a result, two additional items ("MVUENVT", "the product's relationship to the customer use environment", and "MVSTANDARD", "the potential for standardizing the design") were developed making a total of 4 items to measure MV Form, with acceptable reliability ($\alpha = .79$).

Also, with the addition of new items from the second round of expert interviews, the MV Clarity dimension separated into two different factors: MV Clarity and MV Specificity. The addition of two new items (i.e, MVSPEC, "Even in the very early stages of development, prior to formal project status, the market vision was very specific", and MVDIR, "Even in the very early stages of development, prior to formal project status, the Market Vision was able to provide direction to others in the organization") created a situation where the new "MV Specificity" factor was more general and at a higher level of abstraction pertaining to specificity of the overall vision (including form, scope, clarity, etc.). On the other hand, the new "MV Clarity" factor described/represented the clarity of the Market Vision Form only and in a very specific fashion (e.g., MVCLNEED, "In the very early stages of this technology's development it was clear what target customers' needs would be").

The Stage 4 expert review was particularly useful in generating a new list of potential items to measure Early Performance. This was necessitated by the finding in the preliminary analysis (Stage 3, Study 1) that there were problems with the correlation matrix for Early Performance. As such, new items and refinements were suggested by the experts and an EFA was performed with the second data set from the nanotechnology sector. The results of this EFA suggested that the more comprehensive list of items to evaluate Early Performance comprised three factors: Early Success with Customers, Ability to Attract Capital, and Competitive Technical Advantage. The loadings and associated reliabilities are shown in Table 10.

Table 10

Pattern Matrix for Early Performance (EFA)[a,b]

Factor Name	Items (Rotated Factor Matrix)	1	2	3
EP **Early Success with Customers**[c] (χ = 0.82)	Early customers accepted the products stemming from the technology (even prior to sales)	.898		
	Early customers were satisfied (even prior to sales)	.770		
	Customers' needs were (will be) satisfied better by these products than existing ones.	.636		
	Products stemming from the technology (will) provide a competitive advantage (e.g., profits)	.536		
	Linking the advanced technology to a good market application.	.412		
EP **Ability to Attract Capital**[c] (χ = 0.77)	Amount of funding (internal and external) compared to initial request.		.875	
	Ability to attract capital.		.817	
	Avg growth in company employment stemming from involvement with the technology.		.609	
	Cash flow.		.441	
EP **Competitive Technical Advantage**[c] (χ = 0.81)	Innovation's technical quality.			.852
	Innovation's value to the organization.			.832
	Innovation's potential impact on the industry			.691
	Unique benefits: perceived as superior to competitors.			.607

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

a. Rotation converged in 9 iterations.

b. Total of 64% of variance explained.

c. Preamble: "Please indicate the degree of success, which you feel your company has achived (1 = 0%; 7 = 100%)."

In the case of the three EP factors, the correlation results were acceptable (positive determinant, Bartlett chi-square = 581.265 with 0.0 significance and KMO = 0.827), and the best three items for each EP factor were retained (i.e., those with the highest loadings) in order to move forward to the CFA.

4.4.4 Confirmatory Factor Analyses: Preliminary Statistics for MV, MVC and EP

There were items which showed very high residuals in the first runs of the CFAs using both data sets. These items were, therefore, removed prior to running the final CFAs. These

included MLDSS and NWICENTR from MVC; MVIMPACT and MVSOCIET from MV (see Appendix 2); and 4 items from EP (products provide a competitive advantage; innovation's potential impact on industry, amount of funding compared to initial request and linking the technology to a good market application). Removal of these items was necessary to ensure the best possible fit of the measurement models in each case.

The question of whether the construct, MV Discontinuity, should be retained was also answered during the preliminary CFA analysis for MV with the second data set. According to the results, the CFA chi-square was statistically more significant for the model without MV Discontinuity, and the factor itself was the only one that was not statistically related to the other MV factors. Furthermore, given that an analysis to determine a potential second-order factor structure was planned with the final CFAs used for testing the latent structure of MV, it did not make sense to maintain the MV Discontinuity factor in further analyses. Unlike in standard CFA models in which associations between factors are left unanalyzed, the first order factors in a hierarchical or second-order model are presumed to have a common cause that accounts for their intercorrelations (i.e., MV and MVC are presumed to be second-order factors) and, as such, an uncorrelated factor of the first order (i.e., MV Discontinuity) should not be included in the analysis (Kline, 1998).

In summary, as a result of these preliminary CFAs, some items and factors were dropped from further analyses. The complete listings of the items used in the final confirmatory stage analyses for MV, MVC and EP, for both samples administered Questionnaire 2 (Appendix 2), are presented in Tables 11, 12 and 13, respectively.

Table 11

Market Vision: Final List of Items for Confirmatory Factor Analyses

Market Vision Form

When we first started thinking about what specific markets would benefit from the technology, we spent most of our time thinking and talking about:

a. ...how the product would fit into an overall system of use for potential customers (MVSYSTEM).
b. ...ease of use for potential customers (MVUSE).
c. ...the product's relationship to the customer use environment (MVUENVT).
d. ...the potential for standardizing the design (MVSTANDARD).

Market Vision Scope

When we first started thinking about what specific markets would benefit from the technology, we spent most of our time thinking and talking about:

e. ...what the most profitable target market would be (MVPROFTM).
f. ...what the most important target market would be (MVIMPTM).
g. ...what the largest target market would be (MVLGETM).

Market Vision Magnetism

Even in the very early stages of development, prior to formal project status the market vision was:

h. ...important (MVIMPORT).
i. ...attractive (MVATTRAC).
j. ...desirable (MVDESIRE).

Market Vision Clarity

In the very early stages of this technology's development it was clear:

k. ...what target customers' needs would be (MVCLNEED).
l. ...how the product would be used (MVCLUSE).
m. ...who the target market (user) would be (MVCLUSER).

Market Vision Specificity

Even in the very early stages of development, prior to formal project status, the market vision:

n. ...was clear (MVCLEAR).
o. ...was tangible (e.g., easy to visualize) (MVTANG).
p. ...was very specific (MVSPEC).
q. ...was able to provide direction to others in the organization (MVDIR).

Table 12

Market Visioning Competence: Final List of Items for Confirmatory Factor Analyses

Networking

The person who first championed this technology in our firm:

a. ...had a broad network of relationships outside of the company (NWBROAD).
b. ...had an external network made up of people with a variety of different backgrounds (e.g., different industries, different disciplines, different functions, etc.) (NWVARIET).
c. ...was at the center of the external network growing up around the new technology (NWCENTRL).

Idea Driving

The person who first championed this technology in our firm:

d. ...got key decision makers in our firm involved (IDDMKS).
e. ...secured the required senior management-level support (IDSRMGR).
f. ...shared information and campaigned for support very quickly with senior management (IDSRMGR).

Proactive Market Orientation

g. We tried to discover additional needs of our customers of which they were unaware (MLADNEED).
h. We incorporated solutions to unarticulated customer needs in our new products and services (MLUNART).
i. We brainstormed on how customers might use our products and services (MLBRAIN).

Market Learning Tools

j. We tried to keep our market opportunity options open as long as possible for the new technology (MLOPTIONS).
k. We tried to develop several potential technology scenarios before choosing a market(s) to pursue (MLSCENAR).
l. Our understanding of potential markets was updated in light of new information from forecasts (MLBEFORE).
m. We used several forecasting and market estimation techniques in combination before market selection (MLCOMBO).

Table 13

Early Performance: Final List of Items for Confirmatory Factor Analyses

Technical Competitive Advantage

a. Unique benefits: perceived as superior to competitors.
b. Innovation's technical quality.
c. Innovation's value to the organization.

Early Success with Customers

d. Early customers were satisfied (even prior to sales).
e. Early customers accepted the products stemming from the technology (even prior to sales).
f. Customers' needs were (will be) satisfied better by these products than existing ones.

Ability to Attract Capital

g. Average growth in company employment stemming from involvement with the technology.
h. Cash flow.
i. Ability to attract capital.

4.4.5 Confirmatory Factor Analyses: Final Statistics

At this last stage of development (Stage 5), the final versions of the measurement instruments or scales (MVC, MV, and the new EP) were ready for testing utilizing CFA. The purpose of confirmatory factor analysis was to "confirm" the remaining items as grouped into specific factors (first-order factors), as suggested by all of the previous tests in the purification stage. The MV, MVC and EP scale items to be tested were constituted by 17, 13 and 9 items, respectively. Specifically, there were 17 items comprising MV (3 MV Clarity, 4 MV Specificity, 3 MV Magnetism, 4 MV Form and 3 MV Scope), 13 items comprising MVC (3 Networking, 3 Idea Driving, 3 Proactive Market Orientation, and 4 Market Learning Tools) and finally, 9 items for Early Performance (3 Early Success with Customer, 3 Ability to Attract Capital and 3 Technical Competitive Advantage).

4.4.5.1 CFA Results for Sample 2. The confirmatory factor analyses performed on the second sample for MV and MVC both exhibited acceptable fit, as evidenced by the Comparative Fit Indices (CFI = 0.987 and 0.979, respectively) and Root Mean Square Error Approximations (RMSEA = 0.025 and 0.036, respectively). These values satisfy the established criteria for CFI and RMSEA of above 0.90 and below 0.07, respectively (Bollen, 1989). Given chi-square (χ^2) sensitivity to small sample sizes and distributions, the modified version of the indicator (adjusted $\chi^2 = \chi^2/df$) was used as suggested by Browne and Cudeck (1989). In each case the adjusted χ^2 was = 1.1, which is considered to be well within the acceptable upper limits of 2.5 to 4 times the number of degrees of freedom (Bollen, 1989; Carmines & McIver, 1981). No CFA was performed for Early Performance with the second data set because, as mentioned above, with the reworking required for this construct, the second data set was used to perform the EFA.

4.4.5.2 Reliability Tests for Sample 2. Internal consistency reliabilities for each of the constructs, Market Vision (MV) and Market Visioning Competence (MVC), were estimated using Cronbach Alpha. In each case, values were above the minimum acceptable level of 0.70 (Nunnally, 1978). For MV, the coefficients for each dimension were: MV Clarity (0.89), MV Specificity (0.88), MV Magnetism (0.83), MV Form (0.77), and MV Scope (0.82). For MVC, the coefficients for each dimension were: Networking (0.71), Idea Driving (0.76), Proactive Market Orientation (0.77) and Market Learning Tools (0.79).

Next, the construct reliability estimates were computed utilizing the standardized loadings given in the final CFAs (Jöreskog, 1978). For MV, these were: MV Clarity (0.90), MV Specificity (0.88), MV Magnetism (0.84), MV Form (0.78), and MV Scope (0.82). For MVC, the coefficients for each dimension were: Networking (0.72), Idea Driving (0.77), Proactive Market Orientation (0.78) and Market Learning Tools (0.82). All of the indicator t-values were also significant at the $p < 0.05$ level. These results suggest satisfactory levels of reliability for both the MV and the MVC scales.

4.4.5.3 CFA Results for Sample 3. The confirmatory factor analyses performed for MV and MVC on the third sample also exhibited acceptable fit: Comparative Fit Indices (CFI = 0.982 and 0.958, respectively) and Root Mean Square Error Approximations (RMSEAs = 0.030 and 0.046, respectively). These values satisfied the established criteria for CFI and RMSEA (Bollen, 1989). As with sample 2, the modified, adjusted χ^2 (i.e., χ^2/df) (Browne & Cudeck, 1989) was used to take into account sample size issues (size and distribution); these were 1.1 and 1.2, respectively, which is well within the acceptable upper limits (i.e., 2.5 to 4 times the number of degrees of freedom (Bollen 1989, Carmines and McIver 1981).

Using this third data set, a CFA was also performed for the Early Performance construct. While the CFI of 0.903 and the adjusted χ^2 value of 2.0 fell within the established limits, the RMSEA (= 0.1) was somewhat higher than the established cut-off

of 0.07. This indicates that, while the three EP factors can be viewed as three separate factors, further refinement and elaboration of the items comprising them is required in order to develop a more representative Early Performance scale.

4.4.5.4 Reliability Tests for Sample 3. Internal consistency reliabilities were computed using Cronbach Alpha (Cronbach, 1951) coefficients for the three dimensions of MV, MVC and EP. With the exception of the Networking dimension which was borderline, in all cases, the minimum level of 0.70 recommended by Nunnally (1978) was met or exceeded. For MV, the coefficients were: MV Clarity (0.86), MV Specificity (0.89), MV Magnetism (0.70), MV Form (0.70), and MV Scope (0.83). For MVC, the coefficients were: Networking (0.68), Idea Driving (0.79), Proactive Market Orientation (0.77) and Market Learning Tools (0.78). For EP, the coefficients were: Technical Competitive Advantage (0.75), Early Success with Customers (0.84) and Ability to Attract Capital (0.80).

Next, the construct reliability estimates were calculated utilizing standardized loadings from the final CFAs. This calculation was performed using Jöreskog's Rho (Jöreskog, 1978). For MV, these were: MV Clarity (0.87), MV Specificity (0.90), MV Magnetism (0.70), MV Form (0.70), and MV Scope (0.83). For MVC, the coefficients were: Networking (0.70), Idea Driving (0.81), Proactive Market Orientation (0.79) and Market Learning Tools (0.78). For EP, the coefficients were: Technical Competitive Advantage (0.76), Early Success with Customers (0.85) and Ability to Attract Capital (0.81). All of the indicator t-values were significant at the $p < .05$ level. In sum, these indicators suggest satisfactory levels of reliability for the MV, MVC and EP scales.

The reliability tests performed for the second and third datasets show that the items used to measure each dimension (first order factors) of Market Vision, Market Visioning Competence and Early Performance are replicable across two samples. Further, the CFAs performed for the two samples show that the first-order factor structures are also replicable across samples.

4.4.5.5 Latent Structures of Market Vision and Market Visioning Competence Scales: Validity Tests. Given the strong results for the reliability and CFA tests, the next stage (i.e., the second part of Stage 5, Figure 8) of analysis involves testing the structure of the two measurement models for MV and MVC and then testing for their validity. Validity is tested through the evaluation of convergent, discriminant and nomological validities. For this purpose, the second and third data sets are combined in order to enhance the number of responses required for estimation purposes in the measurement models and subsequent structural equation models. Given the reliability of the scales for both samples 2 and 3, and that they originate from the same population, this combination appears warranted. Also, given that the samples were collected over a 6-month time period, a comparison of the chi-square statistics and associated significances between the 2 samples was made for both MV (116.23; 118.85; no statistically significant difference) and MVC (54.33; 56.18; no statistically significant difference). These tests demonstrate configural and metric invariance between samples 2 and 3.

4.4.5.6 Test of Latent Structure: Market Vision Scale. Based on the theoretical and statistical development provided in this dissertation, the scale for Market Vision is hypothesized to exhibit a second-order latent structure reflected by the five first-order factors previously tested (Tepper Tian *et al.*, 2001). This hypothesized second-order model, which is presented in Figure 9, exhibits acceptable fit as shown by its CFI of 0.95, RMSEA of 0.055, and an adjusted χ^2 of 1.5 (Bollen, 1989).

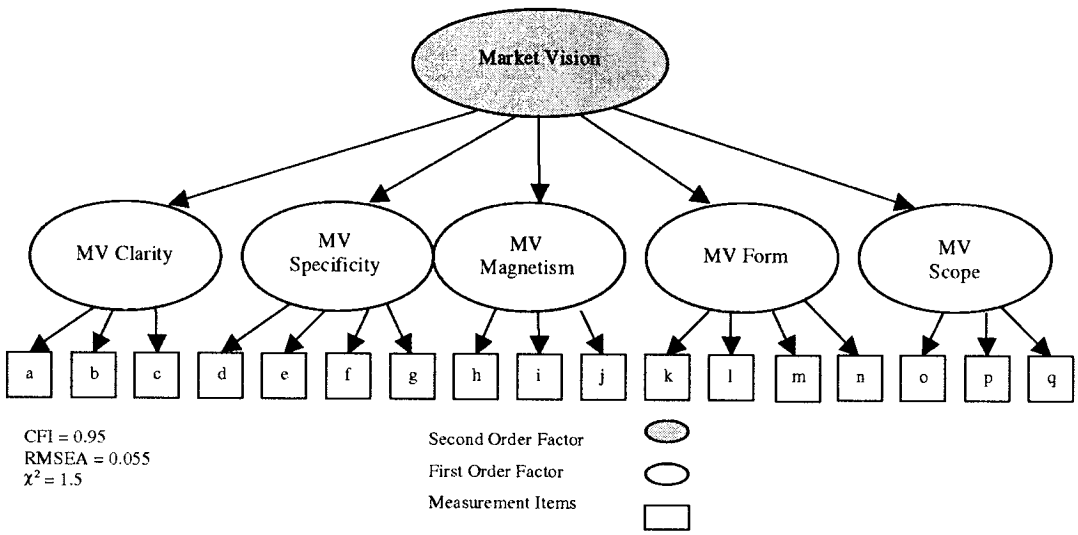
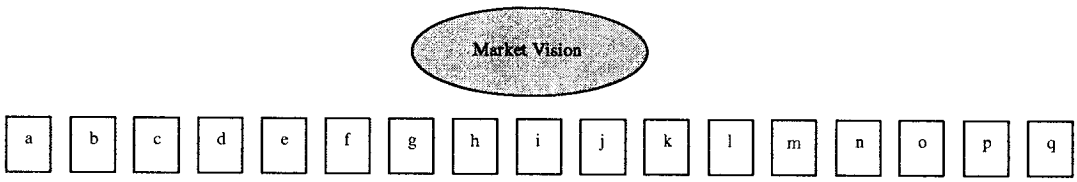
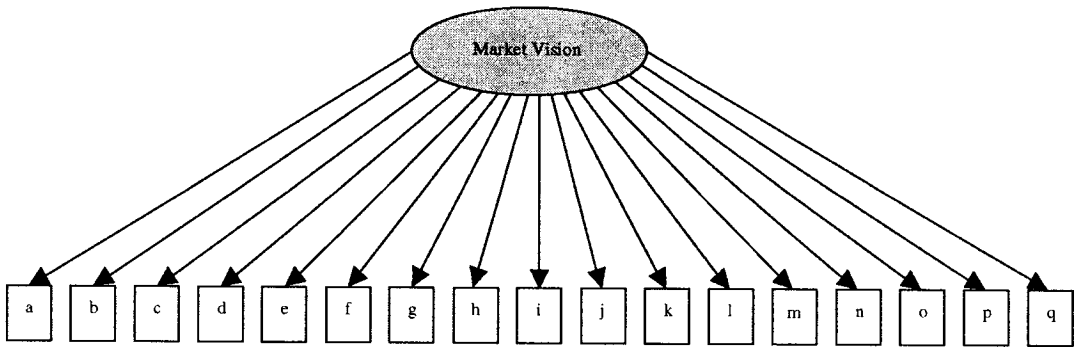


Figure 9. Hypothesized Latent Structure of the Market Vision Measurement Model
Proposed Model[a]: Second-Order
a. Refer to Items in Table 11 by letter as indicated.

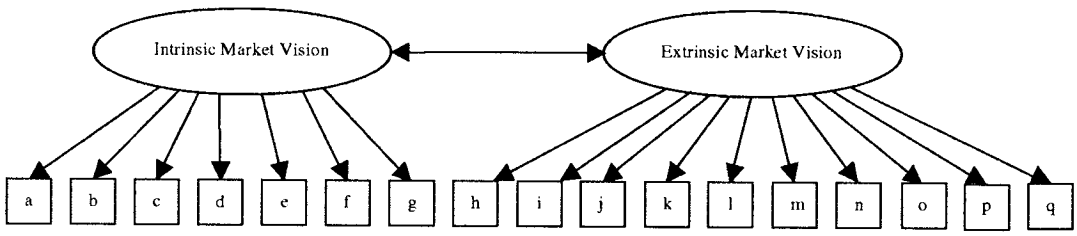
The hypothesized structure, as characterized in Figure 9, is compared with six competing models based on alternative factor structures: the null model in which there are no relationships between any of the variables or factors (model 1); a one-dimensional model in which all items were forced to load on a single factor (model 2); a two-factor uncorrelated model (model 3) in which items related to intrinsic factors (MV Form, MV Magnetism, MV Scope) loaded on one factor and items related to extrinsic factors (MV Clarity, MV Specificity) loaded on another factor; a two-factor (intrinsic and extrinsic) correlated model (model 4); a five-factor uncorrelated orthogonal model (model 5); and a 5-factor correlated model (model 6). The competing models are presented schematically in Figure 10. Table 14 provides the statistical results.



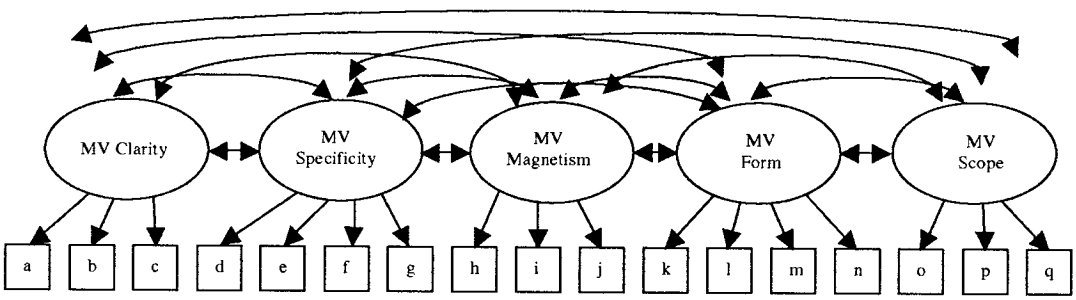
Model 1. The Null Model



Model 2. Forced Single-Factor Model



Model 3. Two-Factor Model (without correlations) and
Model 4.Two-Factor Model (with correlations)



Model 5. Five-Factor Model (without correlations) and
Model 6. Five-Factor Model (with correlations)

Figure 10. Competing Models[a] for the Latent Structure of the Market Vision Measurement Model

a. Refer to Items in Table 11 by letter as indicated.

Table 14 provides the comparative statistical results for the proposed second-order model of the latent structure of the Market Vision measurement model and of the six competing models. These results indicate that the proposed model, as represented in Figure 9, is the most effective model.

Table 14
Comparative Model Fit for Market Vision

Model	Chi-Square	Df	Chi-Square Difference	CFI	RMSEA
Null (model 1)	1153.246	136	n/a	n/a	n/a
1 factor (model 2)	505.755	119	647.49**	.62	.142
2 factor uncorrelated (model 3)	430.965	118	74.79**	.69	.128
2 factor correlated (model 4)	413.284	118	17.68**	.71	.124
5 factor uncorrelated (model 5)	254.164	117	159.12**	.87	.085
5 factor correlated (model 6)	163.152	109	248.11**	.95	.055
Second order (proposed model)	168.502	113	5.35^{ns}	.95	.055

** $p<.05$

In Table 14, each of the competing models is compared for fit to the previous one. The significance of the chi-square difference, taking into account the difference in degrees of freedom, suggests the model that provides the best representation of the data. In the case that the chi-square difference improvement is under the statistical significance threshold, the more parsimonious model—the model with the higher number of degrees of freedom—is selected (Byrne, 1994). A shown in Table 14, the second-order factor model (the proposed model) provides the best fit in comparison with the other models under consideration. While there is no significant improvement between model 6 and the

proposed model, the second-order structure is more parsimonious because it offers more degrees of freedom (113 df for the second-order model vs. 109 df for model 6) and, therefore, is chosen. These findings support the hypothesized structure for Market Vision. The final set of items for the measurement model of Market Vision is presented in Table 15, along with the respective loadings of the items resulting from a CFA performed on the combination of data sets 2 and 3.

Table 15
Standardized Loadings and Reliabilities:
CFA for Measurement Model of Market Vision

Factor Name	Items (Oblimin Rotated Factor Matrix)	1	2	3	4	5
MV **Clarity** (χ = 0.88) Preamble: "In the very early stages of this technology's development..."	...it was clear how the product would be used. (MVCRUSE)	.894				
	...it was clear who the target market (user) would be. (MVCRUSER)	.786				
	...it was clear what target customers' needs would be. (MVCRNEED)	.835				
MV **Magnetism** (χ = 0.78) Preamble: "In the very early stages of this technology's development..."	...the market vision was desirable. (MVDESIRE)		.648			
	...the market vision was attractive. (MVATTRAC)		.836			
	...the market vision was important (MVIMPORT)		.750			
MV **Specificity** (χ = 0.89) Preamble: "In the very early stages of this technology's development..."	...the market vision was clear (MVCLEAR)			.864		
	...the market vision was tangible (e.g., easy to visualize) (MVTANG)			.869		
	...the market vision was very specific (MVSPEC)			.725		
	...the market vision was able to provide direction to others in the organization (MVDIR)			.839		

Continued on next page

Table 15
Standardized Loadings and Reliabilities:
CFA for Measurement Model of Market Vision (continued)

Factor Name	Items (Oblimin Rotated Factor Matrix)	1	2	3	4	5
MV **Form** (χ = 0.74) Preamble: "When we first started thinking about what specific markets would benefit from the technology, we spent most of our time thinking and talking about..."	...how end-user would ultimately interact with and use the product (MVUSE)				.782	
	...how product would fit into an overall system of use for potential customers. (MVSYSTEM)				.558	
	... the product's relationship to the customer use environment. (MVUENVT)				.710	
	... the potential for standardizing the design (MVSTANDARD)				.543	
MV **Scope** (χ = 0.86) Preamble: "When we first started thinking about what specific markets would benefit from the technology, we spent most of our time thinking and talking about..."	...what the most profitable target market would be. (MVPROFTM)					.847
	...what the largest target market would be. (MVLGETM)					.759
	...what the most important target market would be. (MVIMPTM)					.842

4.4.5.7 Test of Latent Structure: Market Visioning Competence Scale. Based on the theoretical and statistical development provided in this dissertation, the scale for Market Visioning Competence is hypothesized to exhibit a second-order latent structure reflected by the four first-order factors previously tested (Tepper Tian *et al.*, 2001). The hypothesized model, which is presented in Figure 11, exhibits acceptable fit as indicated by its CFI of 0.99, RMSEA of 0.017, and an adjusted chi-square of 1 (Bollen, 1989).

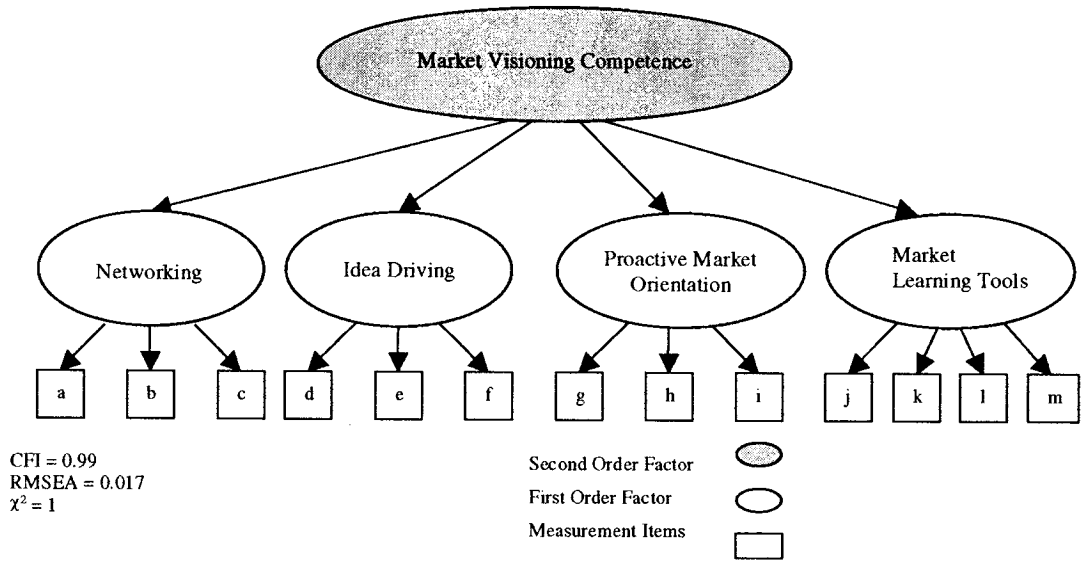
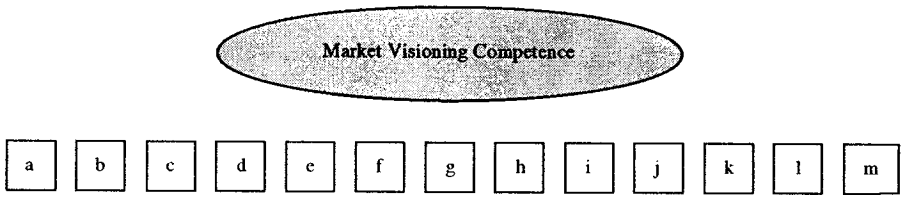
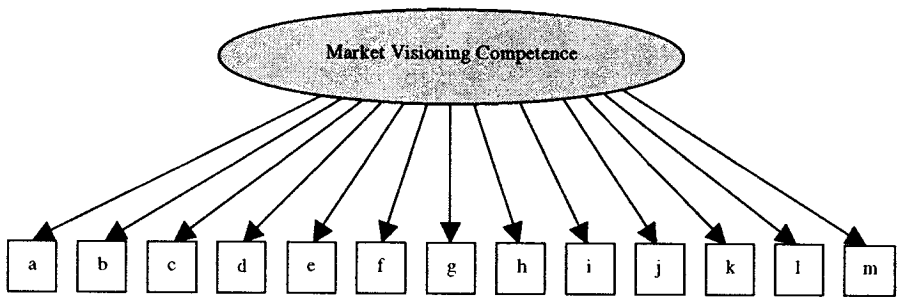


Figure 11. Hypothesized Latent Structure of the Market Visioning Competence Measurement Model[a]
(Proposed Model: Second-Order)
a. Refer to Items in Table 12 by letter as indicated.

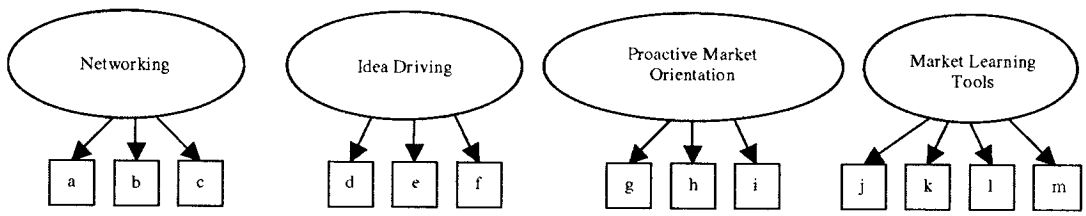
The hypothesized structure, as characterized in Figure 11, is compared with four competing models based on alternative factor structures: a null model (Model 1); a one-dimensional model with all items loading on a single factor (model 2); a four-factor model in which items loaded on 4 uncorrelated factors (model 3); and a 4-factor correlated model (model 4). The competing models are presented in Figure 12 and Table 16.



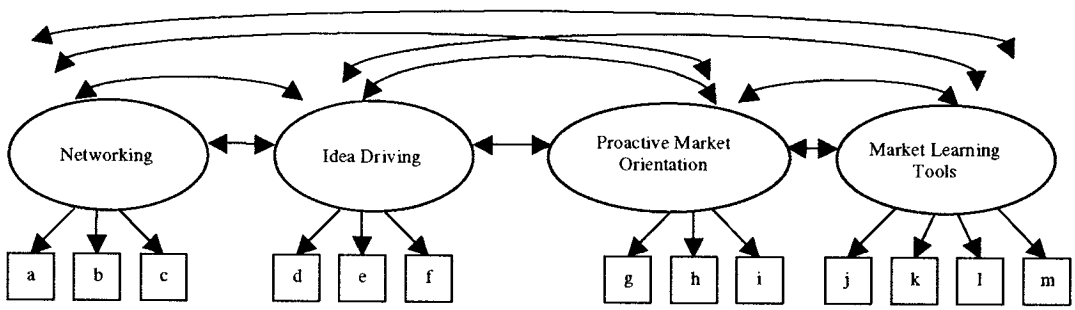
Model 1: The Null Model



Model 2. Forced Single-Factor Model



Model 3. Four-Factor Uncorrelated Model



Model 4. Four-Factor Correlated Model

Figure 12. Competing Models[a] for the Latent Structure of the Market Visioning Competence Measurement Model

a. Refer to Items in Table 12 by letter as indicated.

Table 16
Comparative Model Fit for Market Visioning Competence

Model	Chi-Square	Df	Chi-Square Difference	CFI	RMSEA
Null (model 1)	542.714	78	n/a	n/a	n/a
1 factor (model 2)	321.491	65	221.22**	.45	.148
4 factor uncorrelated (model 3)	111.883	65	209.61**	.90	.063
4 factor correlated (model 4)	65.570	59	46.31**	.99	.025
Second order (model 5)	63.148	60	2.42^{ns}	.99	.017

** $p<.05$

As with Market Vision, competing models of MVC are compared and the most parsimonious model with the best fit is selected. A shown in Table 16, the second-order factor model provides the best fit in comparison with the other models under consideration. While there is no significant improvement between models 4 and 5, the second-order structure provided by model 5 is more parsimonious (60 vs. 59 df) and, therefore, is chosen. These findings support the hypothesized structure for Market Visioning Competence. The final set of items for the measurement model of Market Visioning Competence is presented in Table 17 along with the respective loadings of the items and associated internal consistency reliabilities from a CFA performed on the combination of data sets 2 and 3.

Table 17
Standardized Loadings and Reliabilities:
CFA for Measurement Model of Market Visioning Competence

Factor Name	Items (Rotated Factor Matrix)	1	2	3	4
MVC **Idea Driving** (χ = 0.80) Preamble: "The person who first championed this technology in our firm..."	...got key decision makers in our firm involved. (IDDMKS)	.745			
	...secured the required senior management-level support. (IDSRMGR)	.756			
	...shared information and campaigned for support very quickly with senior management. (IDSHRSM)	.779			
MVC **Networking** (χ = 0.70) Preamble: "The person who first championed this technology in our firm..."	...had a broad network of relationships outside of our company. (NWBROAD)		.738		
	...had a network made up of people with a variety of different backgrounds (e.g., different industries, different disciplines, different functions, etc.). (NWVARIET)		.788		
	...was at the center of the network growing up around the technology. (NWCENTRL)		.484		
MVC **Market Learning Tools** (χ = 0.77)	We tried to keep our market opportunity options open as long as possible for the new technology. (MLOPTIONS)			.682	
	We tried to develop several potential technological scenarios before choosing market(s) to pursue. (MLSCENAR)			.707	
	We use forecasting and market estimation techniques before making a market selection. (MLMEFORE)			.651	
	We use several forecasting and market estimation techniques in combination before market selection. (MLCOMBO)			.648	
MVC **Proactive Market Orientation** (χ = 0.79)	We continuously6 try to discover additional needs of our customers of which they are unaware. (MLADNEED)				.774
	We incorporate solutions to unarticulated customer needs in our new products and services. (MLUNART)				.777
	We brainstorm on how customers use our products and services. (MLBRAIN)				.689

4.4.5.8 Scale Reliability: Test-Retest. Scale reliability for the two construct domains, MV and MVC, was further tested using a test-retest approach. This is achieved through a random selection process provided by the SPSS program (version 12) that separates the sample into two roughly equivalent-sized groups. Satisfactory results were obtained using this methodology, with both groups achieving the 0.70 threshold for the split-half sample for the combined data sets (samples 2 and 3). Specifically, for MV, the items were randomly separated into 9 items in part one and 8 items in part two, with $\alpha = 0.803$ and $\alpha = 0.804$ for parts one and two, respectively. For MVC, the items were randomly separated into 7 items in part one and 6 items in part two with $\alpha = 0.72$ for both parts one and two. Given that there were only 9 items in total for EP, this test was not performed, as the test was not likely to provide meaningful results.

4.4.5.9 Discriminant, Convergent and Nomological Validity. Both the reliability and the structure of the measurement instruments were demonstrated above. Hence, the validity of the measurement models can now be assessed. Validity is concerned with testing whether a variable measures what it is supposed to measure (Bollen, 1989). In order to test this, convergent, discriminant and nomological validities are assessed.

Discriminant Validity. Discriminant validity is "the extent to which the concept considered differs from other concepts" (Zaltman *et al.*, 1973, p. 44). As such, each dimension of each of the scales—MV and MVC—should be different from each another, even though obviously some variance is shared due to the second order factor structures at play. This shared variance is indicated by the fact that the correlations between the MV dimensions were all significant, ranging from 0.151 (MV Clarity to MV Form) to 0.686 (MV Clarity to MV Specificity), with an average inter-correlation of 0.398. For MVC, the correlations between the dimensions were also all significant and ranged from 0.187 (Networking to Idea Driving) to 0.389 (Proactive Market Orientation to Market Learning Tools), with an average inter-correlation of 0.310. The general approach used for testing

discriminant validity in scale development studies (Bearden *et al.*, 2001) was utilized. This approach suggests that there is support for discriminant validity between two constructs when the average variance extracted ("AVE") for each construct exceeds the variance shared between the two constructs (Fornell & Larcker, 1981). Estimates of AVE for each factor, compared to the squared correlations, show evidence of discriminant validity. Tables 18 and 19 present the squared correlations used to determine discriminant and convergent validity for each of the factors comprising MV (see Table 18) and, for MVC (see Table 19). Finally, it was also particularly important in this research to show that the two second-order constructs, MV and MVC, demonstrated clear discriminant validity. In order to test this relationship, the chi-square difference between the free model and the constrained model (where the path between MV and MVC was fixed) verified a statistically significant difference between the two models at the 95% confidence level ($\chi^2 = 15.028$). As such, the two factors, MV and MVC, are considered to be distinct from one another.

Convergent Validity. Convergent validity is defined as "the extent to which two attempts to measure the same concept through maximally different methods are convergent. It is generally represented by the correlation between the two" (Zaltman *et al.*, 1973, p. 44). Convergent validity may be checked by demonstrating that the average variance extracted (AVE) between a construct and its measures falls above a 0.40 threshold (Taylor & Todd, 1995). The calculation of AVE is given by the squared value of the parameter estimates (loadings) provided in the CFA. The results, which give evidence of convergent validity in the case of both MC and MVC, are presented in Tables 18 and 19, respectively.

Table 18

Market Vision (MV): Discriminant and Convergent Validity

Factor and Items	Factor Loading	AVE Value	Factor Correlations	Squared Correlations
MV Clarity		**0.71**	Clarity-Specificity = 0.686	0.47
CRUSE	0.894*	0.800	Clarity-Magnetism = 0.432	0.19
CRUSER	0.786*	0.618	Clarity-Form = 0.151	0.02
CRNEED	0.835*	0.700	Clarity-Scope = 0.378	0.14
MV Specificity		**0.68**	Specificity-Magnetism = 0.510	0.26
MVCLEAR	0.864*	0.747	Specificity-Form = 0.318	0.10
MVTANG	0.869*	0.755	Specificity-Scope = 0.379	0.14
MVSPEC	0.725*	0.526		
MVDIR	0.839*	0.704		
MV Magnetism		**0.56**	Magnetism-Form = 0.297	0.09
MVDESIRE	0.648*	0.420	Magnetism-Scope = 0.474	0.23
MVATTRAC	0.836*	0.699		
MVIMP	0.750*	0.563		
MV Form		**0.43**	Form-Scope = 0.352	0.12
MVUSE	0.782*	0.612		
MVSYSTEM	0.558*	0.311		
MVUENVT	0.710*	0.504		
MVSTANDARD	0.543*	0.295		
MV Scope		**0.67**		
MVPROFTM	0.847*	0.717		
MVLGETM	0.759*	0.576		
MVIMPTM	0.842*	0.709		

* $p < .05$

Table 19

Market Visioning Competence (MVC): Discriminant and Convergent Validity

Factor and Items	Factor Loading	AVE Value	Factor Correlations	Squared Correlations
Networking		**0.47**	Networking-Idea Driving = 0.187	0.04
NWBROAD	0.738*	0.545	Networking-PMO[a] = 0.265	0.07
NWVARIET	0.788*	0.621	Networking-MLT[b] = 0.372	0.14
NWCENTRL	0.484*	0.234		
Idea Driving		**0.58**	Idea Driving-PMO = 0.383	0.15
IDDMKS	0.745*	0.555	Idea Driving-MLT = 0.262	0.07
IDSRMGR	0.756*	0.571		
IDSHRSMR	0.779*	0.607		
Proactive Market Orientation		**0.56**	PMO-MLT = 0.389	0.15
MLADNEED	0.774*	0.600		
MLUNARTIC	0.777*	0.604		
MLBRAIN	0.689*	0.475		
Market Learning Tools		**0.45**		
MLOPTIONS	0.682*	0.465		
MLSCENAR	0.707*	0.500		
MLMEFORE	0.651*	0.424		
MLCOMBO	0.648*	0.420		

a = Proactive Market Orientation

b = Market Learning Tools

* $p < .05$

All factor loadings in Tables 18 and 19 are significant ($p < .05$) and the vast majority of the factor loadings are above the recommended 0.60 threshold (Bagozzi & Yi, 1988). Further, the average variance extracted values greater than 0.40 are suggestive of shared variance with the underlying constructs (Taylor & Todd, 1995). While some references suggest that AVE values of manifest variables should be above 0.50 (e.g., Fornell & Larcker, 1981) for substantial shared variance, the 0.40 cut-off is considered adequate in cases where factor loadings are all above 0.50, reliability is 0.7 and higher, and discriminant validity is satisfactory (Green, Barclay & Ryans, 1995). This is the case for MV and MVC. For MV Form, it should, however, be noted that for 2/4 individual

manifest variables the AVE value is below 0.40. Still, the factor average AVE value is > 0.40 at 0.43, reliability is > 0.70 at 0.74, and the discriminant validity between MV Form and the other factors is strong at 0.12 (i.e., much lower than the AVE of 0.43), and therefore, according to the criteria outlined by Green, Barclay and Ryans (1995) the convergent validity for MV Form is considered acceptable. As such, convergent validity is considered to be satisfactory for both MV and MVC.

Nomological Validity. Nomological validity refers to "the extent to which predictions based on the concept which an instrument purports to measure are confirmed" (Zaltman *et al.*, 1973, p.44). In this study, the main construct of interest is Market Vision, and predictions of relationships to antecedents and consequences, as well as moderators, are proposed (see all Hypotheses), based on the literature review. Further, predictions for the impact of Market Visioning Competence, both on Market Vision and Early Performance, are also made. In this way, a limited nomological check will be made in the next chapter, through Structural Equation Modeling, which will highlight the significance of each of these relationships (Iacobucci *et al.*, 1995, Tepper Tian *et al.*, 2000).

4.5 Summary

The goal of this chapter was to describe details of the Measurement Study. The Measurement Study was facilitated through item generation, purification of the item pool (through expert interviews, personal interpretation and exploratory factor analyses), content validity, specification of the measurement models (through confirmatory factor analyses) and finally, testing of scale reliability and validity. These components of the Measurement Study facilitate testing of the structural model under general and various moderating conditions, as described in Chapter 5.

Chapter 5: Data Analysis and Research Findings

The major purpose of this chapter is to test both the main effects of the general structural model (i.e., the impact of MVC on MV and each of their separate impacts on the components of EP) and also, to examine potential moderating conditions on these main effects. As outlined in Chapter 4, in order to test the general structural model under consideration (Figure 12), analyses were performed on each of the specified constructs in order to verify their psychometric properties. Exploratory factor analysis with each individual latent construct demonstrated adequate reliability, and confirmatory factor analyses showed results (CFI for both samples > 0.96 and RMSEA for both samples < 0.05) suggesting a good fit to the data and the move forward to specification of the structural model. As a result, in Chapter 4, Market Vision (MV) and Market Visioning Competence (MVC) were identified as two distinct domains, each representing a second-order latent construct. A set of five underlying dimensions, shown to be first-order factors, were identified for measuring Market Vision, and four first-order factors were identified as underlying dimensions of Market Visioning Competence. One important question in this research is whether Market Visioning Competence has a positive direct impact on Market Vision (H3). This is tested utilizing the structural model and is presented in this chapter (see Figure 13).

A second question involves the impact of each of these constructs, MV and MVC, on Early Performance (EP). Initially, in Chapter 3, Early Performance had been conceptualized as a uni-dimensional construct and, as such, the impact of both MV and MVC had been hypothesized also to be on one construct (H4, H5). As we saw in Chapter 4, however, Early Performance was re-conceptualized to include three metrics: Technical Competitive Advantage, Early Success with Customers and Ability to Attract Capital. As a result of this refinement for measuring EP, it is necessary to reformulate the hypotheses that impact it. This is done in the following section.

Finally, as per Robertson and Gatignon (1986), the literature suggests that certain environmental circumstances, including firm-level factors, technology factors and competitive factors, may have a moderating influence on the main relationships under investigation (H6 to H12, see Chapter 3). As such, a general model—in other words, the model that includes only the main relationships of interest (H3 and reformulated H4 and H5)—is tested first. After this, the general model is tested under different environmental conditions (moderating effects).

5.1 Reformulation of the Hypotheses Impacting Early Performance

In the measurement study, it was demonstrated that Early Performance can be operationalized in terms of three metrics: Technical Competitive Advantage (TCA), Early Success with Customers (ESC) and Ability to Attract Capital (AAC). Items comprising the TCA factor were suggested from the research of Griffin and Page (1996), which suggest that such a factor is fairly easy to establish early on, prior to sales, and has an important weight in radical innovation situations. The impetus for establishing items which might comprise an ESC factor comes from von Hippel's (1978; 1986) research on the importance of "lead users" at the FFE of NPD, particularly in radical innovation scenarios. Lastly, the idea to use items related to Ability to Attract Capital (AAC) was largely facilitated through an interview with Abbie Griffin, the past editor of *The Journal of Product Innovation*. Further impetus for this idea comes from the literature dealing with the importance of venture capital (Zider, 1998), particularly for entrepreneurial start-ups (Timmons & Spinelli, 2004). As such, it is necessary to theoretically investigate the likeliness that MVC and MV separately impact TCA, ESC and AAC.

At this point, it was decided that the factor comprising TCA should be dropped from further analysis. This was decided because some of the items comprising it, for example "Unique Benefits: Perceived as Superior to Competitors", have too much theoretical overlap with the main construct of interest, Market Vision. Some of the items

comprising TCA had been initially included for the second EFA and CFA testing, based on the suggestion by Griffin and Page (1996), that these were important Early Performance indicators in the case of radical innovations. It was therefore considered important to include them in the overall initial exploratory research to provide a strong metric for Early Performance. Further, *a priori*, it was not known how each of the new items to measure EP would load in the EFA test. Based on the experience with the first questionnaire and initial literature review, it was conceivable that the measure might still be uni-dimensional or be made up of only 2 factors. Further, at such an exploratory stage it is better to be more inclusive, where possible, than less. Therefore, even though there was some theoretical overlap between some of the Market Vision Form items and some of the early performance items, it was considered to be important to include them in the initial exploratory analysis. Once the EFA was performed, however, with the second sample and then further verified using the CFA with the third sample, it became clear that the items loaded on three factors, with the TCA factor clearly having too much theoretical overlap with Market Vision itself. Also, it is believed that other components of Competitive Technical Advantage—for example, "Innovation's Technical Quality"—are more likely to be a result of technical visioning competence, rather than of MVC or MV. Therefore, the factor was removed from further analysis. Nevertheless, TCA is considered to represent an important factor for measuring EP and with further refinement of the items may be a useful metric for future research.

5.1.1 Impact of Market Vision on Early Performance

Using Early Success with Customers as a measure of Early Performance, Market Vision is hypothesized to have a positive impact on this particular outcome measure. The logic underlying this hypothesis is that having a vision of the point of interaction between potential customer and potential product—that is, the Market Vision Form—enables the firm to move forward in a way which is likely to meet customer needs and wants,

especially those of lead users (von Hippel, 1978; 1986). Lead users are those who face needs that will be general in the market months or years before the bulk of the marketplace encounters them. Such users are positioned to benefit significantly by ontaining a solution to those needs (von Hippel, 1978). At the same time, the Market Vision Magnetism element of Market Vision helps to ensure this because individuals in the firm are more likely to be attracted to a goal that has a good possibility of having an impact on the market, as evidenced by Market Vision Scope. Much of the early research in the NPD area supports this idea where pursuing large, and important target markets tends to play out in terms of success (e.g., Cooper, 1979; 1984; de Brentani 1989) and, therefore represent attractive opportunities. While there have been some researchers who suggest that such large markets do not exist in the discontinuous or radical scenario (e.g., Christensen, 1997), this tends to be actually only a short-term reality. It is the ability to forecast the future potential of a market in terms of importance and size that is important, particularly in terms of lighting employee's imaginations on fire. Many of the individuals interviewed in the nanotechnology context for this dissertation described their current markets as small and probably not their "final targets", but that they were using them to learn. This backs up the idea suggested by Gary Lynn and his team (1996) of the importance of patsy markets and "probing and learning" for building competence through the learning involved with small or current markets, while dreaming about and working towards the future. The Market Vision Clarity and Market Vision Specificity elements play an important role in moving more quickly to a shared vision of the future product-market—speed being particularly important in moving towards acceptance at the project level, which should translate ultimately to moving more quickly through the product development process on the whole. This translates into being able to beat potential competitors to the marketplace, and also helping ensuring that the needs and wants of customers do not change too drastically during the time prior to launch (Lynn & Akgün, 2001). In other words, an effective Market Vision allows individuals in the company to

focus on delivering unique benefits to the customer in a user-friendly environment. If individuals in firms are focused on delivering this Market Vision, it is likely to play out in terms of Early Success with Customers.

While Market Vision is hypothesized to positively impact Early Success with Customers (H4a), it is not believed to impact Ability to Attract Capital. Investors tend to focus on management's ability to capitalize on technology and markets. Therefore, as shown below, it is the elements of MVC, rather than MV, which are believed to be tied to the ability to secure capital. In other words, by the time Market Vision is crystallized, capital may already be attracted to the initial technology and broader range of possibilities even prior to the formation of the product-market interface or Market Vision. Therefore, a specific relationship is not drawn between MV and Ability to Attract Capital. In other words, it is hypothesized that there is no relationship between Market Vision and Early Performance: Ability to Attract Capital (H4b).

5.1.2 Impact of Market Visioning Competence on Early Performance

As noted above, the primary impact of Market Visioning Competence, in terms of Early Performance, is hypothesized to be on the Ability to Attract Capital. The capabilities comprising Market Visioning Competence—i.e., Networking, Idea Driving, Market Learning Tools and Proactive Market Orientation—are all important for gaining the attention of financiers, internal stakeholders and potential external new hires. Specifically, Idea Driving helps draw internal attention to the Market Vision (Howell & Higgins, 1990; Howell & Shea, 2001) and ultimately also draws internal resources (both financial and social capital) toward the potential project (Pettigrew, 1973; Schon, 1967). External Networking enables contact with external financiers such as venture capitalists or investment bankers either directly or indirectly (financial capital) (Zider, 1998). It may also draw the attention of potential employees (social capital) and their movement to the potential project (Ettlie, 2000; Granovetter, 1973). A Proactive Market Orientation,

together with external Networking, has the potential to draw both financial and social resources to the project either through potential customers or through the process of collecting new and interesting market information that may lead to competitive advantage (Narver, Slater & McLaughlin, 2000). Lastly, Market Learning Tools, because they may enable several potential market scenarios for a given technology (Porter, 1994; Schoemaker, 1995; 1997) can be exciting to investors as they may see both short- and long-term market opportunities for the technology platform that is developing. In other words, the shorter-term technical capabilities that are being developed in support of a given platform may have the potential to be leveraged to build stronger and new capabilities that enable development of future longer-term product-market opportunities (Wheelwright & Clark, 1992). The ability to develop these scenarios is facilitated through Market Learning Tools. As such, a Market Visioning Competence ensures that a company is able to secure the necessary capital to continue with the venture. Therefore, it is hypothesized that Market Visioning Competence has a significant impact on the Ability to Attract Capital (H5a). This hypothesis is tested in the structural model (see Figure 13).

It is also believed that MVC does not have a significant impact on Early Success with Customers. This is because without a specific product-market focus, as is provided with Market Vision, the capabilities involved with MVC are not directed in a way that enables success with a particular group of customers. While it is true that when dealing with new-to-the-world technologies, potential customers or lead users may bank on a firm that has shown MVC in the past (i.e., in order to reduce risk of adoption), clearly it is the potential of a new technology to solve a customer problem that will play the overwhelming role in attracting customers (as described with MV above). In other words, it is hypothesized that there is no direct relationship between Market Visioning Competence and Early Success with Customers (H5b).

The full set of hypothesized relationships pertaining to EP is presented in Figure 13. The first main hypothesis in the structural relationship is that MVC positively impacts

MV (H3). The second main hypothesis in the structural relationship is that MV has a positive impact on Early Success with Customers (H4a). The third main hypothesis states that MVC has a positive impact on Ability to Attract Capital (Ha). Also, it is hypothesized that there is no causal relationship between MV and AAC (H4b) or MVC and ESC (H5b).

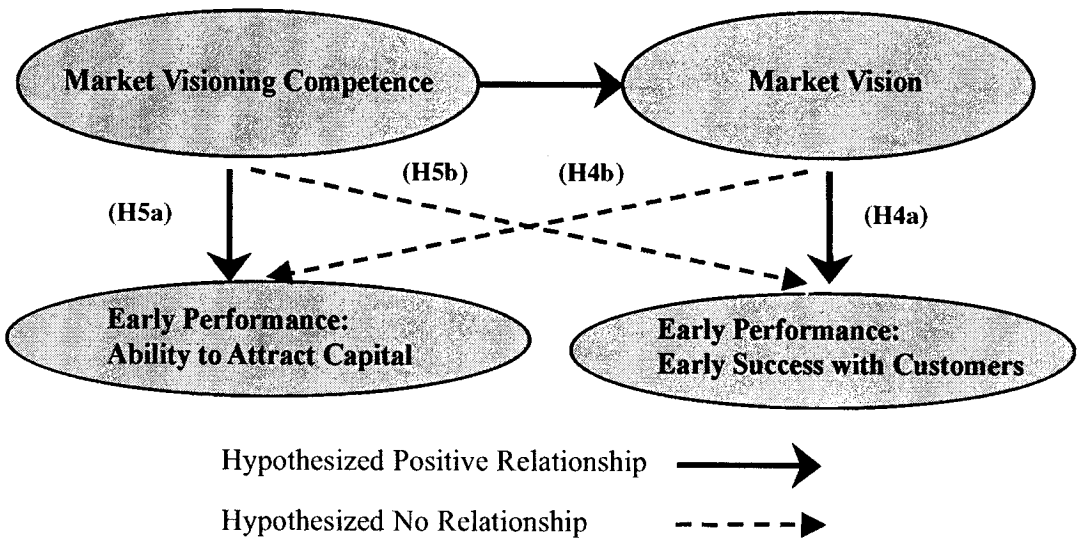


Figure 13. Hypothesized General Model

5.2 Testing the Main Effects of the General Model

Through the use of structural equation modeling, the goal of this part of the dissertation is to depict the strength and valence of the relationships that tie together Market Visioning Competence, Market Vision and Early Performance. The hypothesized model presented in Figure 13 is tested on the overall sample (i.e., samples 2 and 3) using the maximum likelihood method (ML) with EQS software (version 6.1). Specifically, this first set of evaluations examines the underlying pattern of relationships between Market Visioning Competence and Market Vision (H3), Market Vision and Early Performance—Early Success with Customers (H4a), and Market Visioning Competence and Early Performance—Ability to Attract Capital (H5a). Also, the relationships between Market

Vision and Ability to Attract Capital (H4b) and between Market Visioning Competence and Early Success with Customers (H5b) are tested for non-significance. In order to test the general structural model, it is first necessary to perform a measurement model which includes all of the latent construct-variable relationships, but none of the structural paths between latent constructs. The full measurement model is performed prior to the structural model, to ensure adequate fit of the data to the model and as a final verification of the latent relationships.

5.2.1 The General Measurement Model (Full Model: MV, MVC, AAC, ESC)

Analysis of the specified general measurement model is first performed on the overall sample (combined samples 2 and 3, as described in Chapter 4). This model was specified following the measurement and results presented in Chapter 4. Estimation of the model was performed using EQS software (version 6.1). No correlations between errors of the constructs or errors of the items were allowed, thereby giving a conservative estimate of the model (Kline, 1998). The indicators used to get a sense of model fit included: (1) the adjusted chi-square, modified for chi-square's sensibility to small sample sizes and distributions (Bollen, 1989) where acceptable values should be less than 2.5 to 4 times the number of degrees of freedom (Carmines & McIver, 1981); (2) the Comparative Fit Index, utilizing CFI > 0.90 as an acceptability criterion (Hu & Bentler, 1999); and (3) the Root Mean Square Error Approximation (RMSEA) < 0.06 as a cut-off point (Hu & Bentler, 1999). Each of these indicators, as they relate to the analysis in question, is discussed below.

The overall measurement model produced a chi-square value of 754.97 with 579 degrees of freedom (adjusted chi-square = 1.3). The CFI is 0.92 and the RMSEA is 0.041. Each factor was assessed to ensure standardized loadings are significant at the $p < .01$ level (1-tail and 2-tail tests), as shown in Table 20. These findings support the quality of the measurement model and indicate that it is appropriate to move forward to the structural model analysis.

Table 20
Standardized Estimates for the General Measurement Model

Path Tested	**Standardized Estimate (t;p values)**
Networking to Market Visioning Competence	λ = 0.693 (no statistic: set to 1)
Idea Driving to Market Visioning Competence	λ = 0.528 (t = 3.456; p < .01)
Proactive Market Orientation to Market Visioning Competence	λ = 0.576 (t = 3.476; p < .01)
Market Learning Tools to Market Visioning Competence	λ = 0.432 (t = 3.139; p < .01)
Market Vision Clarity to Market Vision	λ = 0.737 (no statistic: set to 1)
Market Vision Specificity to Market Vision	λ = 0.824 (t = 6.804; p < .01)
Market Vision Magnetism to Market Vision	λ = 0.652 (t = 5.638; p < .01)
Market Vision Form to Market Vision	λ = 0.399 (t = 3.571; p < .01)
Market Vision Scope to Market Vision	λ = 0.549 (t = 5.353; p < .01)
Early Customers were Satisfied to Early Success with Customers	λ = 0.804 (no statistic: set to 1)
Early Customers Accepted the Products Stemming from the Technology to Early Success with Customers	λ = 0.944 (t = 11.851; p < .01)
Customer Needs were (will be) better satisfied By These Products than Existing Ones to Early Success with Customers	λ = 0.670 (t = 9.498; p < .01)
Average Growth in Company Employment Stemming from Involvement with Technology to Ability to Attract Capital	λ = 0.732 (no statistic: set to 1)
Cash Flow to Ability to Attract Capital	λ = 0.747 (t = 7.628; p < .01)
Ability to Attract Capital to Ability to Attract Capital	λ = 0.683 (t = 7.370; p < .01)
Fit Indicators	**General Model**
CFI	0.92
Adjusted chi-square	1.3
RMSEA	0.041

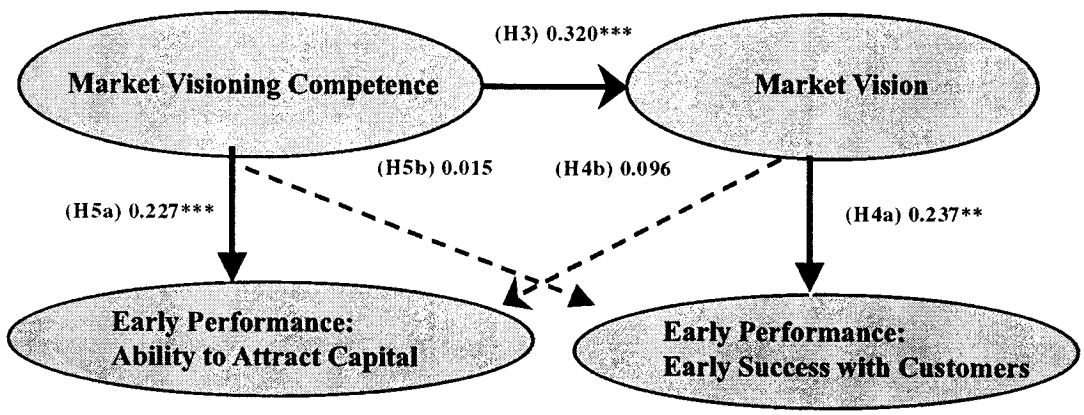
5.2.2 The Structural Model

The structural model was evaluated by adding in the hypothesized structural relationships between the constructs, as indicated in Figure 13. No correlations between errors of the constructs or errors of the items were allowed, thereby giving a conservative estimate of the model (Kline, 1998). The structural model produced a chi-square of 774.43 with 580 degrees of freedom (adjusted chi-square = 1.3). The CFI is 0.91 and the RMSEA is 0.043. All the standardized loadings on the respective latent factors are significant at the $p < .05$ level using the one-tail test. Using the one-tail test, as opposed to the slightly more stringent two-tail test is considered suitable in this situation as the nature of the hypothesized relationships has a directionality to them—i.e., MVC is hypothesized to have a significant positive impact on MV—and, as such, is considered to be a suitable test (Kendall & Stuart, 1979). This supports the quality of the structural equation model and suggests that the structural model has a good fit to the data.

The EQS standardized estimates of the parameters and their respective t-values are presented in Table 21 and Figure 14. As shown in the table, one of the five structural relationships is significant at $p < .05$ ($t > 1.645$, one-tail), and two of five are significant at $p < .01$ ($t > 1.96$, one-tail) (Anderson & Gerbing, 1988). The remaining two structural relationships, as hypothesized, are not significant.

Table 21
Standardized Estimates for the General Structural Model

Path Tested	Standardized Estimate (t;p values)
Market Visioning Competence to Market Vision (H3)	λ = 0.320 (t = 2.47; p < .01)
Market Vision to Early Success with Customers (H4a)	λ = 0.237 (t = 1.75; p < .05)
Market Visioning Competence to Ability to Attract Capital (H5a)	λ = 0.227 (t = 2.37; p < .01)
Market Vision to Ability to Attract Capital (H4b)	λ = 0.096 (t = 0.903; p > .05)
Market Visioning Competence to Early Success with Customers (H5b)	λ = 0.015 (t = 0.137; p > .05)
Fit Indicators	**General Model**
CFI	0.91
Adjusted chi-square	1.3
RMSEA	0.043



CFI = 0.91
RMSEA=0.043

** p<.05
*** p<.01

Figure 14. Structural Model with Standardized Estimates

The strength and valence of the relationships which link Market Visioning Competence to Market Vision, and each of these to two key forms of Early Performance, support the existence of a complex model. Examination of the parameter estimates demonstrates the results of the hypotheses tests, which are described below.

First, the results suggest that Market Visioning Competence has a significant and positive impact on Market Vision ($\lambda = 0.320$, $t = 2.47$, $p < .01$, one-tail test), as hypothesized (H3). This finding provides support for the idea that developing a Market Visioning Competence within the firm is an essential precursor to developing a Market Vision. In other words, the creation of Market Vision is the result of Market Visioning Competence. The underlying first-order factors provide meaning to this result. For example, in order to develop links between potential products and potential markets in people's minds (i.e., Market Vision Form, Market Vision Scope), it is necessary to use MVC by first gleaning information from the external environment by Networking and proactively using Market Learning Tools and then driving these new ideas through the organization. Also, Market Vision Magnetism (for example, importance and desirability of the vision), Market Vision Clarity and Market Vision Specificity are related to MVC dimensions that relate to how well the idea is presented, driven and championed in the organization.

Second, according to the results, Market Vision has a moderately positive impact on Early Success with Customers ($\lambda = 0.237$, $t = 1.75$, $p < .05$, one-tail test). This result supports Hypothesis 4a. Further, it was also possible to test whether Market Vision fully mediates the relationship between Market Visioning Competence and Early Success with Customers. In other words, the hypothesis was tested that there was no direct relationship between MVC and ESC (H4b). The standardized estimate for the link is 0.015 ($t = 0.137$, $p > .05$, one-tail test), showing that this particular hypothesis is also supported—that there is no direct link between MVC and ESC. As such, we can see that Market Vision is necessary to fulfill Early Success with Customers and as such, fully mediates the

relationship between Market Visioning Competence and Early Success with Customers. In other words, because of the underlying dimensions of Market Vision, the focus of the vision is not on how to attract capital; rather, it is on delivering unique benefits and value to the customer in a user-friendly environment. Therefore, individuals in the company must not only emphasize the essence of the vision itself, but this vision must also be magnetic, clear and so forth so that it has the maximum impact on customers in terms of Early Performance.

Third, the results demonstrate that Market Visioning Competence has a strong impact on Early Performance in its Ability to Attract Capital ($\lambda = 0.227$, $t = 2.37$, $p < .01$, one-tail test). This result supports Hypothesis 5a. Market Visioning Competence entails Networking, persuasion through Idea Driving and market learning facilitated through a Proactive Market Orientation and through Market Learning Tools. Excelling in these factors is important if firms are to succeed in gaining the attention of financiers, internal stakeholders and potential external new hires, which put them in a better position to secure the resources to support the venture.

5.3 Testing the General Model under Different Conditions

In this section, the effects of different conditions, or "moderating influences", are tested on some of the structural relationships depicted in the general structural model. The idea of utilizing "moderators" was initially conceived of by psychologists interested in identifying subgroups of individuals for whom predictor-criterion relations are more valid than for other sub-groups (Lubinski & Humphries, 1990). In effect, moderator variables subdivide heterogeneous aggregations of individuals into homogeneous groups either categorically (e.g., by gender) or continuously (e.g. by attitude) for the purpose of examining "differential validity" (Lubinski & Humphries, 1990). In the case of this research, all of the moderators of interest were measured continuously, based on Likert scale responses to subjective questions. One exception is "Firm Size" which was

measured categorically by clustering small and medium-sized firms together (less than or equal to 50 employees) and by clustering large-sized firms together (greater than 50 employees).

As mentioned previously, the literature (e.g., Robertson & Gatignon, 1986) suggests that environmental circumstances, including firm-level factors, technology factors and competitive factors, may have a moderating influence on the main relationships under investigation. It should be noted here that there are two main ways in which a moderating variable can influence a path between two constructs. First, a moderator can influence the path itself. Second, a moderator may influence the nature of the predictor construct in a way which in turn moderates the path to the criterion construct (Lubinski & Humphries, 1990). As such, arguments presented in the following discussion may fall into the realm of either or both of these two types of moderation situations.

A brief summary of factors, which were hypothesized in Chapter 3 to impact the three main relationships in the structural model, are outlined in Table 22. Each potential moderator is defined in terms of a set of specific operational variables, as indicated. These variables were introduced individually, as moderators, to the general model. Using EQS, statistical tests were utilized to determine the effect that each potential moderator has on the main relationships. Testing for each moderator effect involved comparing two sub-samples utilizing a split-mean or "k-means" approach (MacQueen, 1967). For example, in the case of Origin Relatedness, two sub-samples were created: one for "low origin relatedness" and one for "high origin relatedness".

Table 22
Hypothesized Moderators of Main Significant Relationships

Moderator Category	Moderator	Operational Variable (Measure)	Hypothesis
Firm Factors	Origin Relatedness (OR)	• connection between prior work experience and new venture	(H6) Higher levels of OR have a positive impact on the relationship between MVC and MV.
	Firm Size (FS)	• number of employees	(H7) Larger firm size has a negative impact on the relationship between MVC and MV.
	Resource Availability (RA)	• labor, time, equipment, capital, etc.	(H8) Higher levels of RA have a positive impact on the relationship between MVC and MV.
Technology Factors	Appropriability (AP)	• attributes of the innovation allowing firm to capture profits	(H9) Effectiveness of MV, in terms of impact on EP, increases with AP.
Competitive Factors	Industry Concentration (IC)	• number and size of firms operating in industry	(H10)[a] Effectiveness of MV, in terms of impact on EP, increases with lower IC.
	Incumbency (IN)	• % of firms participating in the previous technology it substitutes for	(H11) Effectiveness of MV, in terms of impact on EP, increases with higher levels of IN.
	Reputation (RE)	• Market perceptions of new product innovations and their positive influence on future profitability	(H12)[b] Effectiveness of MV, in terms of impact on EP, increases with higher levels of RE.

a. The wording of Hypothesis 10 changes with the splitting in two of the EP metric, to indicate that the specific hypothesized moderation effect is on the relationship between MV and ESC (described below).
b. Hypothesis 12 becomes Hypotheses H12a and H12b to reflect the splitting in two of the EP metric and also to incorporate further insights in terms of the moderation of the additional relationship between MVC and MV.

5.3.1 Firm Factors as Moderators

As described previously, firm-level factors are one of the three classes of factors which are suggested by Robertson and Gatignon (1986) as likely to have an impact on the supply side of the diffusion process of innovation. Three firm-level factors were hypothesized to have

an impact on the relationship between Market Visioning Competence and Market Vision (H6, H7, H8); these include: Origin Relatedness, Firm Size and Resource Availability.

5.3.1.1 Impact of Origin Relatedness. Origin Relatedness is the connection between prior work experience of the firm and the new venture (Bollen & Hofer, 1998; Teece *et al.*, 1997). Origin Relatedness was measured in the questionnaire using two continuously-scaled questions: (1) "Our company (SBU) is currently focussed only on this technology", and (2) "The technology has an excellent fit with our capabilities, skills, and experience." This hypothesis, with respect to Origin Relatedness (H6), on the relationship between Market Visioning Competence and Market Vision, is based on the idea that higher levels of related previous experience with a given technology and/or market allows individuals to move more quickly from Market Learning Tools, Networking, etc. (i.e., MVC) to forming a Market Vision. This is as opposed to the case where more learning is required due to a lack of relatedness to what had been done in the past.

The results indicate that contrary to expectations, the impact of the moderator, Origin Relatedness, on the relationship between MVC and MV is not statistically significant at the 5% level (χ^2 difference = 0.003, p= 0.959, one-tail test). One explanation for this is that the relationship may be hindered if individuals on whose prior experience the venture depends—that is, who are Networking, Market Learning Tools, etc.—are new blood to the firm who have been brought in specifically for the task of getting involved with the new area of nanotechnology. This is typical in situations of radical innovation, where these types of firms are operating in turbulent environments marked by a lot of growth and change, and also characterized by high levels of employee turnover and movement between firms (Van de Ven *et al.*, 1999). As a result, these individuals do not yet wear the mantel of the firm's previous experience, even though the firm does. In other words, firm-level Origin Relatedness may be subjugated to new individual-level experience.

5.3.1.2 Impact of Firm Size. The second firm-related moderator, Firm Size, was measured categorically using number of employees (Simon, 1945; Burgelman & Sayles, 1986), where small and medium-sized firms were clustered together (less than or equal to 50 employees) and large-sized firms were clustered together (greater than 50 employees). This second moderating hypothesis—i.e., the larger the firm, the greater the inability to move from Market Visioning Competence to Market Vision (H7)—is based on the resistance of larger firms toward the issue of change (Burgelman & Sayles, 1986; Howell & Higgins, 1990). It was therefore felt that large firm size (i.e., firms with greater than 50 employees) would negatively impact the ability to move expediously from Market Visioning Competence to Market Vision.

According to the results, the moderating impact of Firm Size on the link between Market Visioning Competence and Market Vision is not supported ($\chi^2 = 0.730$, $p = 0.393$, one-tail test). The debate (Burgelman & Sayles, 1986; Chandy & Tellis, 2000; Dougherty & Heller, 1994; Kanter, 1988) regarding whether firm size impacts success with discontinuous innovation, has been ongoing for several decades and remains unresolved. The traditional argument suggests that Firm Size can be a hindrance for radical innovation because it negatively impacts information sharing and decision making, due to bureaucracy (see discussion regarding these issues related to Firm Size in Chapter 3). An alternative argument provided by Chandy and Tellis (2000) suggests that larger firms have gradually gotten better at succeeding with innovation, particularly if they are able to implement "dual-innovation streams" to accommodate both incremental and radical innovation processes (Burgelman & Sayles, 1986). One of the reasons for improved new product development performance by large firms is the fact that much academic research over the past three decades on how to improve the innovation process has had a positive impact on firm success. This is particularly true for large firms, as evidenced by Griffin and Page's benchmarking study (1996). Clearly, Firm Size can be beneficial for some things that help move an innovation forward. For example, higher overall resources (or deep pockets), slack resources, R&D

expenditures, and Marketing expenditures have all been found to have a positive impact on innovation success (see Chapter 3). In fact, as we shall see in the upcoming discussion specific to Resource Availability, this particular variable (Resource Availability), which is sometimes related to Firm Size, may be the key to enhancing the MVC to MV relationship. Therefore, while large Firm Size may sometimes hinder the movement from Market Visioning Competence to Market Vision because it is characterized by inertia and hampers information sharing and decision making, this negative impact may be offset by the impetus it provides through commitment of adequate resources. This contrasting or balanced effect may be what underlies the non-significant impact of firm size on the relationship between MVC and MV.

5.3.1.3 Impact of Resource Availability. The final firm-related moderator, Resource Availability, is a measure of the level of labour, time, equipment and financial resources the company has available to move forward in the early stages of the development of the technology (Bower, 1970). Resource Availability was measured in this study by using two continuously-scaled questions: (1) "We had the necessary equipment in the early stages of the development of this technology", and (2) "We had the necessary financial resources in the early stages of the development of this technology". This third moderating hypothesis with respect to Resource Availability (H8) and its potential impact on the link between Market Visioning Competence and Market Vision, is based on the idea that having adequate resources would expedite three processes: first, the ability to move through the external Networking and Idea Driving tasks more quickly en route to forming a Market Vision; second, the ability to work on the technology itself in conjunction with information derived from Networking, Market Learning Tools, etc.; and third, the willingness on the part of individuals to commit to a specific MV because they have gained sufficient information from the environment as embodied in MVC (Li & Atuahene-Gima, 2001).

The results indicate that, as hypothesized (H8), Resource Availability does have a moderating impact on the link between MVC and MV. The chi-square value difference, when the moderator is used, is 3.694 (p=0.055, one-tail test), which is border-line significant at the .05 level and significant at the .10 level. The unstandardized coefficients and related t-values (0.304; 1.745 versus 0.293; 0.801) for high versus low levels of Resource Availability, while in the appropriate direction, are not significant (likely due to the borderline significance at the 5% level using the one-tail test). These findings indicate that Resource Availability, as hypothesized, appears to be important during the fuzzy front-end of the development of radical innovations.

The non-significant findings for Origin Relatedness and Firm Size are most likely related to three key issues. First, large firms appear to be getting better at radical innovation and, therefore, their size does not have as negative an impact on the ability to move forward in the early stages of the process, as was the case historically. Second, given that Market Vision occurs in the minds of individuals, firm-level factors such as Firm Size and Origin Relatedness may not directly impact the movement from MVC to MV. In other words, because Market Vision occurs at the individual level, which is largely not influenced by firms, Market Vision can occur for individuals regardless of whether a firm has one employee or 50,000. Lastly, Resource Availability, which is sometimes related to Firm Size, was found to have a moderately significant impact on the link from MVC to MV, and this appears to isolate the specific situation under which Firm Size can be seen as having an impact in this regard.

5.3.2 Technology Factors as Moderators

In this study, one technology-related factor was studied in terms of its potential moderating impact on the model. The technology factor which was investigated is "Appropriability", or the attributes of the innovation that allow the firm to capture "rent" or profits (Robertson & Gatignon, 1986; Teece, 1988; Winter, 2000). The ability to

appropriate or capture profits is linked to mechanisms which allow the firm to protect its technology from competitive enfringement on its ability to be profitable. These mechanisms often act through giving a firm a longer period of time over which to develop and capitalize on new technologies (Teece, 1998). Three items were used for measuring Appropriability: (1) "We are using patents as a way of protecting this technology", (2) "We have trade secrets to try to protect this technology", and (3) "We are trying to develop the industry standard as a way of protecting this technology". Appropriability was originally hypothesized (H9) to have a positive impact on the ability for Market Visioning Competence to impact Early Performance. As a result of the two new metrics developed for EP, it was necessary to examine the relationships in more detail—that is, to see where Appropriability was likely to have an impact with these new metrics. Patenting is often used as a benchmark by venture capitalists and bankers in their evaluation of whether to invest in a firm or not (Zider, 1998). One of the elements of Market Visioning Competence is Networking and, therefore, if a given individual from a firm is Networking with venture capitalists or bankers, his or her ability to secure capital is likely to be enhanced if patenting has been utilized to enhance Appropriability. Similarly, a firm's ability to show technical competence in the form of secured patents, trade secrets or working on an industry standard, in conjunction with a developing knowledge of markets (through Market Learning Tools and Proactive Market Orientation), acts as a positive signal to potential investors. This, in turn, is likely to enhance a firm's ability to secure a commitment from potential investors. As such, H9 was restated so that the link where Appropriability was likely to have an impact was that between MVC and AAC.

The results indicate that, as hypothesized, Appropriability has a significant moderating impact on the link between MVC and EP (Ability to Attract Capital). The chi-square value difference, when the moderator is used, is 4.000 ($p=0.049$), which is significant at the .05 level (1-tail test). Further, the path from MVC to AAC is significantly different for "high appropriability groups" versus "low appropriability groups".

Unstandardized coefficients and t values are 0.716 (2.541; $p \leq .05$) for high appropriability versus 0.312 (1.665; not significant) for low appropriability.

5.3.3 Competitive Factors as Moderators

Three competitive factors have been highlighted as likely to moderate the relationship between Market Vision and Early Performance (Early Success with Customers). The three competitive factors included in this study are: Industry Concentration, Incumbency and Reputation. As with the technology factor, it was necessary to restate the original hypotheses to reflect the addition of the new Early Performance Metrics to the general model. These are taken into account in the reworked hypotheses below.

5.3.3.1 Impact of Industry Concentration. Industry Concentration reflects the number of firms operating in the industry (Robinson, 1988). This moderator was measured utilizing one item: "A large number of firms are competing with us for the same end application of this technology." Large numbers of firms in an industry are indicative of low industry concentration, and in this case there are likely to be higher levels of competitive activity. It is also usually an indication that the technology life cycle is fairly young, providing fertile ground for radical innovation (Abernathy & Utterback, 1978). Because such high levels of competition tend to move innovations both through the firm and to market more quickly in the race to succeed in the marketplace (D'Aveni, 1994), they are likely to impact the link between MV and ESC. As such, Industry Concentration is hypothesized to positively impact the relationship between Market Vision and Early Performance (Early Success with Customers) (H10).

According to the results, the hypothesized moderating impact is only partially supported ($\chi^2 = 2.410$, $p = 0.121$). The relationship is in the hypothesized direction (i.e., positive) but only of borderline significance at close to the 10% level (one-tail test). The path from MV to ESC is significantly different for "low industry concentration groups" versus

"high industry concentration groups". Unstandardized coefficients and t-values are 0.846 ($t = 2.478$; $p < .05$) for low industry concentration versus 0.279 ($t = 1.103$; not significant) for high industry concentration. In other words, low levels of industry concentration (i.e., a large number of firms) do appear to have an impact on the relationship between MV and ESC. This finding, although borderline, makes sense given the sample in question. The nanotechnology industry has achieved a certain critical mass or, in other words, a large number of players (low industry concentration) now validate the innovation. When more players are in the marketplace, awareness of a new radical innovation builds more quickly. Also, dominant designs, based on higher levels of competition, emerge more quickly. Therefore, Market Vision translates into Early Performance with customers more easily and more rapidly in scenarios where industry concentration is lower.

5.3.3.2 Impact of Incumbency. Incumbency reflects the proportion of firms participating in a new technology that also participated in the previous technology (Gilbert, 1989). In this study, Incumbency was measured using one question: "Almost all firms working with this technology also participated in a previous generation of the technology", where 1 = almost no firms and 7 = almost all firms. Incumbency is hypothesized to have a positive impact on the relationship between Market Visioning Competence and Market Vision because industry expertise can help move innovations through the firm to the market more rapidly.

In this case (H11), the moderating impact of Incumbency on the relationship between Market Visioning Competence and Market Vision was fully supported by the findings ($\chi^2 = 3.887$; $p = 0.049$). Further, the path from MVC to MV is significantly different for "high incumbency groups" versus "low incumbency groups". Unstandardized coefficients and t-values are 0.930 ($t = 3.462$; $p \leq .05$) for high incumbency versus 0.156 ($t = 0.960$; not significant) for low incumbency. These results support the idea that higher levels of Incumbency, where firms from the previous generation of the technology are also involved in the new generation, bring a certain level

of expertise to the equation. Similar to Origin Relatedness at the firm level, this Incumbency know-how at the industry level helps to move things along from Market Visioning Competence to Market Vision. Here, part of the impact of Incumbency, has its influence on firm capabilities that are a part of Market Visioning Competence. For example, industry know-how may be reflected in the Market Learning Tools utilized across the industry. It may also be reflected in the ability to learn from customers because of knowledge of how important Proactive Market Orientation is. Additionally, incumbency sometimes brings with it industry linkages at the firm-level with government, alliances and so forth. Such institutional links can be instrumental in providing industry information and insights into public policy which can give an edge in the marketplace by directing firms as to which product-market applications are likely to be most successful. Such capabilities are typically higher for incumbents than for new firms. Therefore, a higher lever of Incumbency at the industry level means that there will be more industry know-how, both in terms of the technology and the marketplace, and this will help shift Market Visioning Competence to Market Vision in the industry as a whole.

5.3.3.3 Impact of Reputation. Reputation, or credibility, is a firm asset related to market perceptions regarding new product providers and their positive influence on future rents (Wernerfelt, 1984). Reputation was measured with two items: (1) "Our firm will likely become well-known in the industry for our work with this technology", and (2) "Our firm has a good reputation in this industry for our work with this technology". High positive levels of firm reputation are related to good perceptions held by a firm's various publics. As such, not only should diffusion from MVC to MV speed up due to credibility, but also goodwill and trust with customers should be enhanced (Kramer & Tyler, 1996; Murphy, 2002; Robertson & Gatignon, 1986). As such, reputation is hypothesized to impact both the relationships between Market Visioning Competence and Market Vision and also, between Market Vision and Early Performance (Early Success with Customers).

In both cases (H12a and H12b), the moderating impact of Reputation is supported by the findings. The paths from Market Visioning Competence to Market Vision and from Market Vision to Early Performance (Early Success with Customers) were both found to be statistically significant (χ^2 = 5.518, p = 0.024; χ^2 = 5.679, p = 0.017, respectively, one-tail tests). Further, both of these paths are significantly different in cases where there is a "high reputation level" versus a "low reputation level". Unstandardized coefficients and t values are 0.455 (t = 2.540; $p \leq .05$) and 0.429 (t = 2.882; $p \leq .05$) for high reputation level vs. 0.248 (t = 0.553; not significant) and 0.004 (t = 0.036; not significant) for low reputation level. These findings indicate that a solid reputation in the industry is a strong magnet for attention and support. In other words, a good reputation can create a halo effect when companies develop relationships with new customers and when they build on old relationships when developing new products. Such a halo effect can have the impact of transferring positive feelings from one experience to the next. Thus, a company with a good reputation will not only be in a good Networking position in the external environment, which is an important component of Market Visioning Competence, but also this type of company can use past relationships to build acceptance for new product ideas externally, particularly those that are radical. Not only will lead users be influenced by good reputation, but the decisions made by a company with a good reputation tend to be copied by competitors. This will bring attention to specific product-markets over others, and also will influence lead users. The external Networking and internal Idea Driving components of MVC are therefore enhanced by good reputation and this, in turn, enhances Market Vision. Additionally, the confidence created through good reputation probably means that individuals working for a given firm with that type of reputation will be less hesitant about making decisions that enable deciding on a MV. As a result of good reputation, therefore, external acceptance of ideas by early customers will increase, thereby enhancing the link between Market Vision and Early Performance.

5.4 Summary

This chapter presented the results of the tests of the structural relationships in the main model—that is, the antecedent relationship of Market Visioning Competence to Market Vision and the impact of each of these on Early Performance—and the results of the tests of the general model under various moderating effects. First, hypothesized relationships in the general model were tested, all of which were supported by the data. It was found that: (1) Market Visioning Competence positively impacts Market Vision (H3), (2) Market Visioning Competence positively impacts Early Performance through the Ability to Attract Capital (H4), and (3) Market Vision positively impacts Early Performance through Early Success with Customers (H5). The general model was then tested under different moderating conditions utilizing multi-group comparisons. While two firm-level factors (Origin Relatedness (H6), and Firm Size (H7)) were found not to have a significant impact on the main effects of the model, one firm-level factor (Resource Availability (H8)), one technological factor (Appropriability (H9)) and competitive factors (Industry Concentration (H10), Incumbency (H11) and Reputation (H12)) were found to have different levels of effect on the general model. These findings were discussed.

Chapter 6: Conclusions and Implications

This final chapter of this dissertation includes the following sections. First, an overview of the major theoretical contributions and implications is presented. Second, the chief practical contributions are summarized. Third, limitations of the dissertation are discussed; and finally, recommendations for potential future research are presented.

6.1 Theoretical Contributions

In this section, each of the major research findings is briefly stated in terms of its theoretical contribution, relevant conclusions are drawn and their implications for Early Performance of firms engaged in the development of radically-new products are discussed.

Theoretical Contribution 1:

Development of a quantitative scale to measure Market Vision

In order to meet the key objective of this dissertation, to develop a better understanding of Market Vision (MV), a critical concern was to develop a scale that enables the measurement of this concept. This objective was achieved and, as such, is considered to be a primary theoretical contribution of the dissertation. The development of a valid and reliable multidimensional measurement scale demonstrates the depth and complexity of the Market Vision construct. Specifically, the different facets of Market Vision were shown to include: MV Clarity, MV Specificity, MV Magnetism, MV Form and MV Scope. In other words, Market Vision is shown to be a second-order construct represented by five first-order factors. These dimensions (i.e., the first-order factors) offer a more complete and accurate picture of what Market Vision is and provide some idea about why a given MV may lead to better or poorer Early Performance. Also, the set of five first-

order factors provide evidence that vision is more than just an intrinsic form of mental model—i.e., magnetism, form, scope. It is shown also to have extrinsic components—i.e., clarity and specificity. Hence, whereas the intrinsic factors speak to the essence of vision, these extrinsic factors relate to the need for further development and elaboration of the vision, which allows it to be better understood, forwarded or shared, and eventually to be adopted by others.

This five-part configuration, in the form of a multi-dimensional measurement scale, makes an important contribution to future research. While MV Clarity had previously been operationalized for use in testing project vision (Lynn & Akgün, 2001), there was no evidence in the extant literature of any of the other constructs having been operationalized. Instead, the intrinsic components, and also the importance of specificity (extrinsic) had been described only in qualitative terms, pertaining to organizational vision, in the work of Collins and Porras (1995). In effect, although Market Vision has been an important topic of discussion by practitioners and in the popular press, the concept has never undergone detailed development or testing as a theoretical construct. Prior to this dissertation, no qualitative or quantitative research had been done specifically in the area of Market Vision. Hence, the theoretical development and articulation of this construct is completely new and developing and testing a scale for Market Vision represents an important contribution to the field.

Theoretical Contribution 2:

Development of a quantitative scale to measure Market Visioning Competence

A second theoretical construct, Market Visioning Competence, was also elaborated in this dissertation. The research in this dissertation not only enabled the construction of scales by which to measure both MVC and MV, but also effectively demonstrated that these are two distinct constructs. This is an important contribution because in most previous research and articles—both academic and non-academic—the terms visioning and vision

have been used interchangeably and it was important to show that they are two completely different concepts.

To this end, qualitative themes for understanding Market Visioning Competence, suggested by the case studies of Colarelli O'Connor and Veryzer (2001), provided a starting point. These were elaborated in this dissertation utilizing the research of Burt (1992), Colarelli O'Connor and Veryzer (2001), Granovetter (1973), Howell and Shea (2001), Narver, Slater and MacLaughlan (2000), and Schoemaker (1995). The literature suggested that, for radically-new products, it is often the informal (e.g., Idea Driving) and external activities (e.g., Networking, Proactive Market Orientation and Market Learning Tools) that play an important role in creating a Market Vision. The research of Howell and Shea (2001) provides measures of champion strength, some of which were utilized to measure Idea Driving, and the research of Narver, Slater and MacLaughlan (2000) provided a scale, adopted in its entirety, for measuring Proactive Market Orientation. All other items comprising the MVC scale were developed in this dissertation, utilizing a broad literature review in conjunction with interviews, as a basis. Thus, while Colarelli O'Connor and Veryzer (2001) suggest themes for understanding Market Visioning Competence, the framework development (developed dimensions and second-order factor structure) and the actual construction of concepts (item development) around which to understand these themes, as well as their empirical testing, was done specifically in the context of this dissertation.

Further impetus for developing the Market Visioning Competence scale in this thesis was to provide evidence of nomological validity for the study of Market Vision. In order to test nomological validity, the main construct of interest—in this case, Market Vision—needs to be tested in a framework with a related and possibly antecedent construct; in this case, Market Visioning Competence. In order to provide this overall framework, it was necessary to develop a scale to measure Market Visioning Competence and in this way to separate out the underlying Market Visioning Competence construct

required to reach an end-state of Market Vision. In order to demonstrate that these two constructs are distinct, a test of discriminant validity was performed between the two second order constructs. This test supplied evidence that the two constructs are indeed distinct. In conjunction with the results of the structural equation modeling, strong evidence of nomological validity of Market Vision was provided through the inclusion of the Market Visioning Competence component in the study.

Theoretical Contribution 3:

Development of a new Early Performance Metric

Firm performance, in new product development, whether at the product, platform/program or company level, has typically been measured utilizing standard post-launch metrics such as market share, revenue, revenue growth, unit volume, number of customers, profitability, margins, IRR, ROI, break-even time, speed to market, total development cost, windows of opportunity and time-to-launch (see Griffin & Page 1996 for a complete review). Since Market Vision deals with the early, pre-project stages of radical innovation involving advanced technology, most of the standard measures of project-level performance are inappropriate. Not only are most of these measures temporally far-removed from the FFE of NPD in the case of radical innovation, but for many companies interviewed for this research, they have not launched products yet—and so, these measures are not relevant or meaningful for them.

Extensive review of the literature indicated that no comprehensive metric for Early Performance, during or as a direct outcome of FFE activities and/or decisions, has been utilized previously in empirical research. This presented a challenge in studying companies involved with real-time emergent technologies at the Market Vision stage of discontinuous innovation, as this represents a pre-revenue phase of the NPD process. Hence, another key contribution of this research is the advancement of two metrics for measuring Early Performance: (1) the Ability to Attract Capital and (2) Early Success with

Customers. These are good measures at this early FFE stage because interest from lead users/customers and/or venture capitalists/financiers are often good indicators of further success down the line in the NPD process. Each of these factors was operationalized in multi-variable terms and tested utilizing exploratory factor analysis and confirmatory factor analysis. Moreover, they were used in the final structural equation modeling as outcome (dependent) variables dependent on Market Visioning Competence and Market Vision. As such, not only do these metrics provide a further element for testing the nomological validity of Market Vision, but they also provide specific outcome measures for use in studies of Early Performance with discontinuous innovations.

Theoretical Contribution 4:

Statistical evidence of the differential impact of Market Vision on Early Success with Customers

The results of the structural model analysis indicate that the main impact of Market Vision, in terms of Early Performance, is on Early Customer Acceptance of new products resulting from emerging radical technologies. This presents an important theoretical contribution because it extends our understanding of both the NPD process and the relevant success factors at the fuzzy front-end. This contribution was achieved by providing empirical evidence of the importance of early thinking about the target market and its interaction with the product. Specifically, it is possible to see that envisioning this point of interaction, between potential customer and potential product (Market Vision Form), enables individuals and teams in the firm to move forward more quickly through the initial screening process, initial feasibility studies and into the development and design stage in a way which is likely to meet customer needs and wants. The Magnetism and Scope elements of Market Vision, in particular, help to ensure this because team members are only apt to be attracted to a goal that is seen as having a major impact on the market. The Clarity and Specificity elements also play a role because these aspects help to move people more

quickly to a shared vision of the future product-market. For radical innovations, speed can be particularly important both for the purpose of beating potential competitors to the marketplace and for ensuring that customer needs and wants do not change too drastically during the time of development and launch. In other words, an effective Market Vision allows individuals in the company to focus on delivering unique benefits to the customer in a unique environment. If individuals in firms are focused on delivering this Market Vision, it is likely to play out in terms of Early Success with Customers.

Theoretical Contribution 5:

Statistical evidence of the differential impact of Market Visioning Competence on the Ability to Attract Capital

According to the results, the main impact of Market Visioning Competence, in terms of Early Performance, is on the Ability to Attract Capital. Clearly, this is a contribution to knowledge as it provides empirical evidence of the importance of the types of capabilities (i.e., various skills, systems and values) that firms must focus on when developing a Market Visioning Competence. These capabilities were grouped into individual dimensions (e.g., Networking, Idea Driving) and organizational dimensions (Market Learning Tools) which provide the first-order constructs reflecting the underlying holistic, multi-dimensional, second-order antecedent construct, Market Visioning Competence. These empirical findings provided the basis for a scale for developing and testing the hypothesized relationships between MVC and MV and MVC and AAC. For example, Idea Driving helps draw internal attention to the Market Vision and ultimately also draws internal resources toward the potential project (both financial and social capital). External Networking enables contact with external financiers such as venture capitalists or investment bankers either directly or indirectly (financial capital). It may also draw the attention of people to the project such as potential employees (social capital). A Proactive Market Orientation linked with external Networking has the potential to draw both

financial and social resources to the project either through potential customers or through the process of collecting new and interesting market information that looks like it will lead to competitive advantage (and this will again draw the attention of both potential employees and financiers). Lastly, Market Learning Tools, because they enable several Market Visions (or Market Vision scenarios) can be exciting to investors as they may see many short- and long-term opportunities for the technology platform that is developing. As such, Market Visioning Competence ensures that a company is able to secure the necessary capital to undertake or continue with the venture. Developing the MVC scale and testing the hypothesized relationships not only provided answers to some of the main research questions of this thesis, but also provided a strong basis for future research.

Theoretical Contribution 6:

Evidence that moderating factors—Firm, Technology and Competitive Factors—show multi-group differences and therefore provide evidence of moderating the main effects in the model

Analysis of moderating effects enabled an expanded theoretical understanding of the general model under various environmental situations.

One *firm-level* factor which was shown to be significant in impacting the relationship between Market Visioning Competence and Market Vision was Resource Availability. Not surprisingly and as suggested by the RBV, access to adequate firm resources (i.e., equipment, people, money), enables the ability to move through external Networking, Market Learning Tools and Idea Driving tasks more quickly en route to forming Market Vision. It also means that not only will this process occur more quickly than otherwise, but also that it will occur more effectively.

The *technology* factor which was investigated as a potential moderator in this research is Appropriability, or the attributes of the innovation that allow the firm to capture "rent" or profits. The ability to ultimately appropriate or capture profits is linked to

mechanisms such as how patentable the innovation is. Appropriability was found to moderate the ability of Market Visioning Competence to positively impact Early Performance (the Ability to Attract Capital). In other words, intention and future ability to patent enhances the relationship between Market Visioning Competence and Ability to Attract Capital by providing proof of the future potential of a technology to deliver "rent". Also, for those individuals involved in the development of the technology, the need to work on technology issues for the patenting process will help to crystallize ideas about future potential product-market applications. Appropriability is used as a benchmark by venture capitalists and bankers in their evaluations of whether or not to invest in a firm. One of the elements of Market Visioning Competence is Networking and, therefore, when individuals from firms network with venture capitalists or bankers, their ability to secure financial capital is likely to be enhanced by patenting or the intention to patent. This finding is particularly important in this research, as one key question firms often ask is whether or not it is worth patenting an innovation. The concern cited is one of protection of intellectual capital (i.e., because when patents are filed, they become public) particularly from off-shore companies who sometimes do not respect the patenting infrastructure. This has been of major concern to the emerging nanotechnology sector and, as such, this finding with respect to Appropriability provides important information with respect to the importance of patenting for a key Early Performance dimension, the securing of capital.

Three *competitive* factors—Industry Concentration, Incumbency and Reputation—were found to each moderate at least one of the main effects in the structural model. Industry Concentration (i.e., number of competitive players) was found to moderate (positively) the relationship between Market Vision and Early Performance (Early Success with Customers). Specifically, low Industry Concentration—i.e., large numbers of players with of a variety of sizes—validates a given innovation. In other words, when more players are in the marketplace (i.e., low Industry Concentration), awareness of a new radical

innovation is likely to build more quickly; also, dominant designs, based on higher levels of competition, will emerge more quickly.

Incumbency (i.e., higher levels of Incumbency indicate a larger proportion of firms that participated in the previous technology) was found to moderate the relationship between Market Visioning Competence and Market Vision. Higher levels of Incumbency, where firms from the previous generation of a given technology are also involved in the new generation, bring a certain level of expertise to the equation. This know-how at the industry level helps to move things forward from Market Visioning Competence to Market Vision. Part of the impact of Incumbency, however, is on the firm capabilities that make up Market Visioning Competence. For example, industry know-how may be reflected in the Market Learning Tools utilized by firms across a given industry; and it may also be reflected in the ability to learn from customers, because of an appreciation of how important Proactive Market Orientation is. These firm-level capabilities are likely to be higher for incumbents than for new firms. Additionally, incumbency sometimes brings with it industry linkages at the firm-level with institutions, such as the government. Such links can be instrumental in providing insights into public policy, or providing other industry information, which helps direct firms as to which product-market applications have the biggest chance of success in the marketplace.

Reputation, or credibility, positively moderates the relationships between Market Visioning Competence and Market Vision and, between Market Vision and Early Performance (Early Success with Customers). These findings indicate that a solid reputation in the industry, or at least a growing one, will drive the interest of lead users in the industry. A good Reputation is likely to create a halo effect related to developing new relationships and building on old ones when developing new products. Such a halo effect can help to transfer positive feelings from one seller-buyer experience to the next. As such, a company with a good reputation can use it to leverage acceptance for new product ideas, particularly those that are radical.

Theoretical Contribution 7:

A real-time analysis of an emerging industry

Surveys of truly emergent phenomena are often conducted post-hoc; indeed, often decades after an innovation has unfolded. Carrying out the research for this dissertation offered a rare opportunity to learn about and report on the early stages of an emergent technology unfolding in real time. Because the research covers what is happening in real time (i.e., not retrospectively), there is a greater likelihood of obtaining accurate information, based on recall. Respondents were, for the most part, discussing their current technologies undergoing development and, as such, were able to provide a clear explanation of the current/recent MVC activities and decisions, of the MV pursued and of the EP results. This is in contrast to most studies of high-technology products, which are conducted at later stages where recall may be requested for technological developments that occurred years in the past. This real-time study facilitated gaining an appreciation of some of the key factors that impact early success when firms are involved in developing radical new technologies into new-to-the-world, high-tech products. The development, in this dissertation, of the Early Performance metric allows for an earlier snap-shot of the innovation process to be captured.

6.2 Practical Contributions

In addition to the theoretical contributions, this dissertation makes some important practical contributions for managers in terms of how to deal effectively with the FFE of NPD in the radical innovation scenario. These are briefly stated, relevant conclusions are drawn, and their implications for Early Performance of firms engaged in the development of radically-new products are discussed.

Practical Contribution 1:

Building Awareness of Importance of Market Visioning Competence and Market Vision

In the short term, the findings of this research have the potential to build awareness for managers involved with radical innovations as to what Market Visioning Competence and Market Vision are. Further, operationalization of the MVC and MV scales articulates for companies what the key components are that comprise these two constructs. In many cases, firms that are involved with radical innovations, tend to be too focussed on technical solutions, and are not aware of many of the marketing activities that need to be carried out early on in the process to be successful with radical innovations. Awareness of the dimensions that entail each of these latent constructs will allow companies to begin to focus on developing and/or emphasizing key non-technical competences to improve their Market Visioning Competence and Market Vision.

Practical Contribution 2:

Benchmarking Tools for managers to evaluate their Market Visioning Competence and Market Vision strength, and chances of success with Early Performance

A key challenge often described by managers is their inability to realistically gauge how they are doing when it comes to the very early stages of their involvement with a radical innovation. The Market Vision and Market Visioning Competence scales developed in this dissertation and the empirical results, as to their relationship to EP, provide an opportunity to help firms evaluate in real terms their current emphasis and performance in this regard and disseminate this information in the form of tools by which companies can potentially measure their performance with regard to their MVC and the strength of their MV. The long-run impact has the potential to reduce the risk and thereby improve the chances of success for companies committed to improving their level of competence in market visioning and in the strength of their market vision. One way to facilitate this is to use the

top 20% of performers in terms of the Early Performance metrics and provide a benchmark in terms of their average scale measurement for each item. For example, knowing the degree of emphasis (i.e., average value/score) the top performers (in terms of AAC) place on each dimension comprising the Market Visioning Competence scale could provide a benchmark for firms in developing their capability in this regard. Similarly, for respondents in the top 20% of firms, with regard to Early Success with Customers, the average scores for each dimension comprising the Market Vision scale could provide a relevant benchmark. In other words, by understanding the underlying dimensions that comprise MV and MVC together with their benchmark scores, a potential tool is available for companies in their self-assessment and to operate as a compass for improvement. For firms that score well, this information may also be of interest, up front, to financiers and to lead users in order to show in the event they do well vis-à-vis the benchmarks, given the empirical findings of this research. Finally, given that success with financiers and lead users are indications of excellent Market Visioning Competence and strong Market Vision, respectively, it may be a good idea for firms to seek validation as early as possible from financiers and lead users—as these players are the ultimate judges of success at these stages. Additionally, by using the top performers as a benchmark, the statistical model can be used with new data from individual firms to determine where they rank in relation to the benchmarks. With this information, they are in a better position to decide which areas are specifically in need of improvement.

Practical Contribution 3:

The first known large-scale academic survey of the newly emergent Nanotechnology Sector

The nanotechnology sector, the focus of the empirical component of this dissertation, is being touted as the "next big thing" to have a revolutionary impact on our lives and in the most important consumer and business sectors of the economy. Two billion dollars

of government money, worldwide, has already been pumped into the nanotechnology sector since the beginning of the decade (2000). Further, according to the Lux Research Nanotech Report (2004), spending on research in 2004 for nanotechnology was approximated at $6 billion (more than double the $3 billion 2003 level). The U.S. National Science Foundation predicts that the total market for nanotech products and services will reach $1 trillion by 2015. Given the importance of nanotechnology, in terms of the large number of business and consumer markets that it will impact, an important contribution of this dissertation is its potential to provide specific feedback about this sector. The focus on MV and MVC company capabilities, in this regard, has the potential to enhance both company and industry performance in this critical sector of the economy. Many of the companies studied will likely be involved in developing more than one Market Vision. This is either because they are utilizing patsy markets to leverage success with longer term markets, or because they are building more than one technology platform. Such companies may be able to use the information provided by this research to improve their Market Visioning Competence so that they are able to attract more capital for future projects and so that their future Market Visions are successful with lead users. Moreover, to the extent that developments in the nanotechnology sector are generalizable to future high-tech, fast-moving industries, companies in these emergent industries of the future, will be better able to use the information provided to better leverage Market Visioning Competence and Market Vision, in terms of impact on Early Performance.

6.3 Assumptions and Limitations

As with all research, this dissertation is based on certain assumptions and has some limitations. These must be taken into account when generalizations about the results are made beyond the present research context.

Two primary assumptions were made as follows:

1. that respondents who took part in the study provided their assessments of Market Visioning Competence and Market Vision as they perceived them prior to the time of initial screening and before the idea was accepted for further development; and
2. that the respondents who participated in the empirical study made an adequate assessment of the participation criteria requested of them (i.e., that they have been involved in the development of a recent technology development for their firm that was both radical and high-tech, according to the definitions supplied).

Each of these assumptions deals, in part, with the validity of the ratings made by the evaluators. It is believed that these assumptions are reasonable. In the case of the first assumption, the survey clearly outlined that the respondents were to think about the nature of these projects prior to the time when the development of the technology became a formalized project. Where relevant, the wording of the questions was specifically crafted in order to put people into the appropriate frame of mind (i.e., prior to the first screen of an idea). For example, the preamble to some of the questions dealing with Networking started as follows: "let's look at the external networks that your firm (SBU) participated in BEFORE the project got the green light for formal development" (the word before was highlighted as well). As such, the assumption that respondents were thinking about their involvement with the technology, prior to the first screen, is reasonable.

Regarding the second assumption, operational definitions for the terms "high tech" and "radical" were provided both over the telephone during the respondent recruiting process and on page one of the survey. In both cases, it was made clear to potential participants that it was necessary for them to meet these basic participation requirements. If they did not meet them, they were thanked for their time and asked not to take part in the study. In this way, an appropriate pool of potential respondents was culled from all of the likely candidates who had been identified and contacted from the known universe of nanotechnology companies.

This dissertation also has a number of limitations. Seven primary limitations of the study are listed and discussed below:

1. The Early Performance metrics developed in this research should be considered exploratory; further research needs to be undertaken to flesh out more and/or better items.
2. It was not possible to test all of the potential moderating variables, which had been identified in the theoretical literature.
3. This dissertation provides a cross-sectional examination of the phenomena of interest, but not a longitudinal one.
4. Due to limitations of sample size, implications of cross-cultural impacts were not investigated.
5. Additional items for some of the first-order factors might lead to increased reliability levels (although all meet the basic criteria).
6. The open-ended nature of the expert interviews made classification of responses more difficult than if a more restrictive methodology had been utilized; however, the method used did allow for more in-depth probing of experts than would have otherwise been possible.
7. One respondent per company was utilized and a single perspective can usually not tell the whole story.

First, the Early Performance metrics developed in the context of this dissertation need to be re-tested in future research, using the scale development criteria of Nunnally (1967). This is to enhance completeness both in terms of items and constructs. While the factors that were developed were sufficient to the task in this study, it is recommended that the metrics be tested using a third empirical sample. Further, a third potential dimension to measure Early Performance was suggested in the exploratory factor analysis—a "technical advantage" dimension—however, it was considered to have too much theoretical overlap with the Market Vision construct, itself, to proceed with testing it in

the confirmatory factor analysis. As such, it is recommended that further items be fleshed out and tested for the measurement of technical advantage, in order to ascertain whether this third Early Performance metric exists.

A second limitation in this dissertation has to do with the testing of potential moderating variables. Several additional variables, over and above those used in these analyses, were gleaned from the literature, including: order of entry, marketing expenditures and R&D expenditures. Order of entry, however, was not tested in the context of this research because the extant literature has not provided clear empirical results regarding its impact on firm performance. Further, because the overall impact of order of entry, itself, is likely to be moderated by several other factors, there was not a straightforward theoretical basis for including order of entry as a moderator in the model under study. Regarding R&D expenditures and marketing expenditures, their inclusion was not enabled due to the feasibility of collecting valid data (for example, responses to questions about these types of expenditures were difficult to solicit for confidentiality reasons).

Third, this dissertation provides a cross-sectional examination of the phenomena of interest, but not a longitudinal one. As such, it is not possible to explore the way in which Market Vision changes over time, how multiple MVs are managed over time, and whether the relative importance of the components of MVC and MV change as a technology moves through its life cycle. Suggestions for studies along these lines are developed in the section on "Future Research".

Fourth, while it was possible to draw some preliminary (non-statistical) conclusions regarding the differential impact of some of the factors of interest in this study for U.S. vs. "other" respondents, the latter category did not allow for in-depth cultural difference conclusions, due to sample size. Here too, suggestions are made with respect to this issue in the section on future research.

Fifth, although all of the first-order factors comprising Market Vision and Market Visioning Competence met the basic criteria for reliability, there is potential for

improvement. In particular, for one of the Market Vision factors, "MV Magnetism", it was felt that with the addition of new, more specific, items the current magnetism factor might split into two factors: an intrinsic MV Magnetism factor and an extrinsic MV magnetism factor. The intrinsic factor would be similar to what MV Magnetism is now: an internally important, desirable magnetic vision to individuals within the firm. Initial evidence at the exploratory factor analysis stage indicated that an external MV Magnetism factor might exist, incorporating ideas such as: the importance of the Market Vision to society, its potential market impact, etc. These two items loaded together at the exploratory stage; however, two items are not enough to test a factor adequately. Future research might build on this finding.

The sixth limitation deals with the issue of using expert interviews. These interviews were useful, particularly for eliciting items for the first questionnaire, then getting feedback on items that were problematic, and identifying new items for the second questionnaire. Due to their open-ended nature, there was some difficulty in classifying responses. It would have been useful to develop a more thorough classification system as this might have helped up-front in reducing problematic items (which had to be removed due to poor results in the factor analyses anyway) and later on in eliciting new items. For example, Zaichkowsky's (1985) methodology could be utilized whereby four expert judges are given each construct's definition (first and second-order) and asked to rate each statement as clearly representative or not representative. Only items in the top 2 categories (by at least ¾ of the judges) would be maintained. The longitudinal study suggested in the future research section, as well as the effort to include additional scale items (for example, magnetism, technical advantage, and other Early Performance metrics), would benefit from such a methodology.

Lastly, the seventh limitation is related to the situation that the data for this study were collected utilizing the "key informant" technique (Bonner *et al.*, 2002; Huber & Power, 1985; Kumar *et al.*, 1993). The concern with key informants, in this case, is that individuals

from small-group clusters (e.g., team members) and senior managers may be representative of two predominantly distinct "collective views" within the organization (Gonzalez-Roma *et al.*, 1999). As such, representatives from each of these views were included in the sampling process, to overcome this concern. While the key informant technique is a prevalent survey methodology for empirical research of this nature, where company access is often restricted, conclusions should be interpreted with this potential bias in mind. Future studies with multiple respondents would be recommended, if a possibility.

6.4 Future Research

Recent research in marketing encourages the use of both historical and longitudinal studies as a way of broadening our understanding of marketing phenomena (Golder, 2000). Such studies (for example, Marinova, 2004; Slotegraaft & Inman, 2004) provide rich contexts to broaden and enrich the level of understanding with complex phenomena such as those studied here. In particular, longitudinal studies can be useful in cases where the complexities of a marketing phenomenon cannot be fully captured at a given point of time through cross-sectional research. For example, network theory, involves relationships which unfold over time. In order to better understand the nature and impact of these relationships, it is useful to examine them over a period of time, as was done in the research by Anderson *et al.* (1994) in their study of dyadic business relationships. In this dissertation, the studies conducted were of a cross-sectional nature. But, because Market Vision is a phenomenon that evolves and changes over time, a cross-sectional approach provides opportunities to building a better understanding of Market Vision. This is related to each individual being asked to comment on the phenomena of interest only at one point in time—in this case, in the early stages of technological development, prior to first screening. While this enables capturing the basic essence of Market Vision, it does not allow us to penetrate the time period—which in some cases, may last for up to 10 years—during which it plays a role and learn about how things change over time.

Therefore, moving from a cross-sectional to a longitudinal mode can potentially facilitate an improved level of understanding of the phenomenon. For example, in the Lynn and Akgün (2001) study, the dimension of "vision stability" was introduced but not considered to be a significant variable in determining Project Vision for radical innovations. But given that vision tends to be elaborated over time and sometimes changes either due to external pressures (e.g., venture capital pressures to pursue "lower hanging fruit" than initially intended) or intentionally (e.g., as in the case of patsy markets where the plan is to use short term product-market opportunities to leverage longer term ones), the non-significance of this dimension might be linked to the cross-sectional nature of their study. Such potential changes in Market Vision are further evidenced in some of the quantitative results of this dissertation. For example, Market Learning Tools for the most part involved keeping options open and being flexible to the many potential applications available during the development of an emergent technology. Thus, a study of how the valence of Market Vision changes over time, and how time-based changes in specific dimensions of Market Vision influence Early Performance would provide further insight to the topic, using a longitudinal analysis.

An enhanced understanding of the impact of Market Visioning Competence and Market Vision on Early Performance might additionally be provided by computer-based experimental approaches (Reibstein & Chussil, 1997). For example, an interactive environment might be designed and utilized with an expert panel to see how various Market Learning Tools, Idea Driving and Networking techniques, specifically work to create different visions. Then, it might also be possible to see how competing visions perform in different theoretical future environments (designed by inputting various environment contingencies, constraints and opportunities).

Another potential avenue for future research would be to examine the impact of different cultures in the world. Specifically, studies could assess how culture affects the dimensions of Market Vision and Market Visioning Competence, and how these, in turn,

impact various aspects of Early Performance. Based on Hofstede's (1980) framework, propositions could be formulated in which "communal" cultures are more likely to move forward with one vision very quickly, forfeiting the use of multiple Market Vision scenarios as a tool for leveraging multiple opportunities. While speed might be gained, potential impact might be lessened. On the other hand, "individual" cultures might spend more time in the building-MVC-stage, creating divergent scenarios and hashing out differing views of the future. While the impact might be greater, there may be a price to be paid for slower entry in the marketplace.

Finally, while the research presented in this dissertation focused specifically on Market Vision, it was proposed in the theoretical discussion that Market Vision is likely to lead to a specific Project Vision, which ultimately dictates or re-orients the much broader Organizational Vision. These ideas need to be further elaborated and tested in order to provide a comprehensive understanding of the role of vision at various levels of analysis.

6.5 Concluding Remarks

Market Vision is a complex marketing phenomenon important to gaining success with Radical Innovation. Understanding the components of Market Vision and of Market Visioning Competence, enabling measurement of these two key dimensions, understanding their antecedent relationship to each other and to Early Performance were the primary objectives of this dissertation. In addition, a study of moderators in terms of their impacts on the construct relationships was provided. Based on a broad literature review, the articulation of a theoretical model, and a major empirical study of an emerging high-tech industry, these objectives were successfully met. By doing so, crucial gaps in the theoretical and managerial literatures were filled. For example, enhancement of the extant literature, through contributions to theory, includes a complete articulation of the MV and MVC constructs provided as scales for future research, the development of an Early Performance metric for use in the early stages of NPD with radical innovation, and

confirmation of the hypothesized relationships between these three constructs. Further, important practical outcomes were provided including: a potential "best practices" tool for enhancing Market Visioning Competence and Market Vision, and an analysis of a "real-time" emergent industry. Lastly, this research opens the door to an entirely new research stream on Market Vision.

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Appendix 1: New Product Development Survey

Questionnaire 1

Graduate Researcher:
Susan E. Reid
Ph.D. Candidate
Concordia University
Montreal, Canada

In this academic study, I seek to better understand how organizations link advanced technology developments with market opportunities of the future. I value your opinions and would appreciate your cooperation in filling out this questionnaire.

Your answers will remain completely confidential. All evaluations are based on averages and no individual company data will be published in any way. While you are not under any obligation to complete this questionnaire, your assistance will help academics and managers in general to better understand and better manage under conditions of radical new product development.

Some of the **benefits** you may gain from this study are:

- Data will be gathered from other companies, permitting the creation of average values. Your organization will be able to **compare your activities and results with the average values.** I shall be glad to make these values available to you after the analyses are complete.
- After all the data is collected, a profile of "best practice" firms (top 20%) will be prepared. The results will be made available to you upon request, enabling you to **compare yourself with the "top" performers.** You will be able to assess the areas in which you are doing well and which ones present a major challenge.
- The questionnaire deals with many aspects that could be of great importance to your firm. When answering these questions, **topics may be raised that may not have been considered before and which may be of use to your firm in the future.**

I look forward to your involvement!

New Product Development Survey

Thank you in advance for taking part in this study. Please read the following before answering the questionnaire.

1. In this study, I am asking you to provide data about you and your company's involvement with **ONE new technology** that your company has either already developed into product(s) or is in the process of developing into product(s). The technology (and products stemming from it) that you choose to consider in answering this questionnaire should be considered both "high-tech" and "radical" in nature. Please refer to the following definitions to help you select the most appropriate scenario:

What is meant by "high-tech"?

- $\geq 6\%$ of sales (or worth, for new companies) are spent on R&D

What is meant by "radical innovation"?

- "new-to-the-world"
- Operationally, we can consider a radical innovation to be any one that either improves performance in the range of at least 5- to 10-times improvement or reduces costs by at least 30%.

2. **What is meant by "company"?**

- In some companies, there is only one new product development (NPD) program for all products.
- Other firms handle multiple product/market segments using relatively autonomous divisions or SBUs (Strategic Business Units), where each unit has its own approach to NPD and strategy formulation. If the SBU scenario is yours, please **answer all questions** for your **division/SBU**.

Please, identify below the company, the division/SBU (if applicable) and your general role. This information will only be used to sort the data and will not be published or used in any other manner.

Company Name _____

Division/SBU (if applicable) _____

I was (am) a member of the team developing this technology: Yes/No

I was (am) a member of senior management: Yes/No

Continued on next page

The ratio of my R&D/Marketing expertise could be measured as:

RATING

All R&D Neutral All Marketing

1——2——3——4——5——6——7 _____

Please mark **X** if not in any way applicable to you

3. Most questions may be answered by filling in the blank with a number that best corresponds with the scales at the top of each page. In a few instances, however, specific scales are utilized for given questions and are provided beside or underneath those questions, where applicable. Even if some questions appear similar to others, please answer them all, as this is important for my analysis. Exact answers are not necessary. Just give your best estimate. **Thank you for your assistance!**

Definately Not	**RATING**	Definitely Yes
Strongly DISAGREE	Neutral	Strongly Agree

1——2——3——4——5——6——7

Please mark **X** if not in any way applicable to you

PART I. Let's begin by classifying THE TECHNOLOGY **you are discussing in this questionnaire.**

1. The technology is totally "new-to-the-world". ____
2. The manufacturing process is totally "new-to-the-world". ____
3. Our company (SBU) is currently focused only on this technology. ____
4. The technology has an excellent fit with our capabilities, skills, and experience. ____
5. We were slow to adopt this technology because ...
   a) ... it was very complex. ____
   b) ... it had a high degree of uncertainty. ____
   c) ... it was difficult to observe. ____
   d) ... it was difficult to understand. ____
   e) ... it required the combination of more than one scientific area of expertise. ____
   f) ... it was difficult to try out on a limited basis. ____
6. We considered the technology risk to be very high. ____
7. We considered the market risk to be very high. ____

PART II. Next, let's talk about **HOW YOUR FIRM COMPETES** with this **TECHNOLOGY.**

1. This product is targeted to customers outside our company's traditional customer base. ____
2. We were at the forefront of the industry in developing this technology (i.e. we were pioneers). ____
3. This product requires unfamiliar channels of distribution. ____
4. A great number of firms are seeking the same end application as we are for this technology. ____
5. I would estimate the ratio of small to large companies for this technology to be approximately: ____

All small	**RATING**	All Large
Companies	About 50/50	Companies

1——2——3——4——5——6——7

Please mark **X** if not in any way applicable to you

6. Almost all firms working with the current generation of technology also participated in an earlier generation. (1 = almost no firms; 7 = almost all firms) ____
7. Large "old network" firms have all the market power with this generation of the technology too. (1 = 0%; 7 = 100%) ____
8. This technology is "competence destroying" for the "old guard" of companies. ____

Definately Not	**RATING**	Definitely Yes
Strongly DISAGREE	Neutral	Strongly Agree

1——2——3——4——5——6——7

Please mark **X** if not in any way applicable to you

9. We were able to identify "lead users" of the technology ahead of the competition. ("lead users": anticipate general needs of the marketplace months/years before others) ____
10. Our organization is located near a university, which has a strong competence in the technology. ____
11. Getting involved in this technology required cannibalizing some previous technology investment. ____
12. We had the necessary capital equipment in the early stages of the development . of this technology ____
13. We had the necessary financial resources in the early stages of the development of this technology. ____

PART III. Next, let's look at the **NETWORKS** that your firm (SBU) participates in.

1. In networking with the environment outside our firm, we interact closely with...
   a) ... external financiers, such as venture capitalists or bankers. ____
   b) ... government officials. ____
   c) ... academics from regional university(ies). ____
   d) ... alliance companies (e.g. with those that have complementary marketing capabilities). ____
2. When developing ideas for new products, we intentionally interact ...
   a) ... with our more innovative customers. ____
   b) ... with our more innovative suppliers. ____
3. We regularly access available government financial resources ($). ____
4. We regularly access available government non-financial resources (e.g., database access). ____
5. Our firm has research sites in different locations. ____
6. The research going on at the firm's other research sites is very similar to the research at our site. (1 = completely different; 7 = all the same) ____
7. We actively recruit personnel whose skills permit involvement with radical new technologies. ____
8. Our firm is ...
   a) ... well-known in the industry. ____
   b) ... has a good reputation for pioneering technology in the industry. ____
   c) ... almost always an industry leader with new important technologies. ____
   d) ... at the nucleus of new industry groups forming around important new technologies. ____

Definately Not	**RATING**	Definitely Yes
Strongly DISAGREE	Neutral	Strongly Agree

1——2——3——4——5——6——7

Please mark **X** if not in any way applicable to you

PART IV. In general, **HOW ARE NEW IDEAS DRIVEN** both inside and outside the organization?

1. When a major radical technological opportunity comes along, we move quickly to assess whether we need to change our current product development strategy. ____
2. We actively push for external development of complementary systems or infrastructures. (e.g. digital camera manufacturers and special computer paper for printing out digital images) ____
3. We actively push for internal development of complementary systems or infrastructures. ____
4. Information regarding potential technology/marketing opportunities is
   a) ... quickly and widely spread throughout the organization. ____
   b) ... fed to management quickly by customer-contact employees. ____
   c) ... fed to management quickly by R&D employees. ____
5. Who drives new technical ideas in the firm:

All R&D	**RATING**	All Marketing
	About 50/50	

1——2——3——4——5——6——7 ____

Please mark **X** if not in any way applicable to you

6. We have a technical advisory committee to steer the development of new technologies. ____

PART V. In general, **HOW ARE NEW IDEAS PROTECTED** in your organization?

1. We use patents as a way of protecting our technology. ____
2. We have trade secrets to try to protect our technology. ____
3. We try to develop the industry standard as a way of protecting our technology. ____

PART VI. How does your firm **LEARN ABOUT AND INTERACT WITH THE MARKET**?

1. Before committing ourselves, we try to keep our potential market opportunity options open for new technologies. ____
2. The original market we had targeted for the technology was not the market we eventually launched to. ____
3. With radically new technologies, we actively seek to develop...
   a) ... niche markets to learn more about the technology before going after the mass market. ____
   b) ... markets which don't exist yet. ____
   c) ... more than one market. ____

Definately Not	**RATING**	Definitely Yes
Strongly DISAGREE	Neutral	Strongly Agree

1——2——3——4——5——6——7

Please mark **X** if not in any way applicable to you

4. Co-developing products with "lead users" of advanced technologies helps us to anticipate the needs of future markets. ("lead users": anticipate general needs of the marketplace months/years before others). ____
5. Co-developing products with suppliers of advanced technologies helps us to anticipate the needs of future markets. ____
6. We help our customers anticipate technology developments in their markets. ____
7. We continuously try to discover additional needs of our customers of which they are unaware. ____
8. We incorporate solutions to unarticulated customer needs in our new products and services. ____
9. We brainstorm on how customers use our products and services. ____
10. We innovate even at the risk of making our own products obsolete. ____
11. We search for opportunities in areas where customers have a difficult time expressing their needs. ____
12. We extrapolate key trends to gain insight into what users in a current market will need in the future. ____

PART VII. What **MARKET LEARNING TOOLS** does your firm use?

1. To get feedback, we approach potential customers as quickly as possible with new prototypes, even if these are not perfect. ____
2. We try to develop several potential technology outcomes or scenarios before choosing which product-markets to pursue. ____
3. We use forecasting and market estimation techniques before making a market selection. ____
4. We use several forecasting and market estimation techniques in combination before market selection. ____
5. Our organization is highly "visionary" when it comes to selecting the right markets. ____
6. We have a structured way of capturing lessons learned about past innovations, both good and bad. ____
7. We use a decision support system (e.g. a database) to help forecast market opportunities. ____

PART VIII Before this project got the green light for formal development. How was **SUPPORT** gained to move this project to the "GO" stage for formal development?

1. The person who first championed this technology in our firm...
   a) ... had a broad network of relationships outside of the company. ____
   b) ... had a network made up of people with a variety of different backgrounds. (e.g., different industries, different disciplines, different functions, etc.) ____
   c) ... was at the center of the network growing up around the new technology. ____

Definately Not Strongly DISAGREE			RATING Neutral			Definitely Yes Strongly Agree
1	2	3	4	5	6	7

Please mark **X** if not in any way applicable to you

d) ... was well connected inside our company. ____

e) ... played a central role in the industry development of the technology. ____

f) ... got key decision makers in our firm involved. ____

g) ... secured the required senior management-level support. ____

h) ... got problems into the hands of those who could solve them. ____

i) ... got the right people involved in the innovation. ____

j) ... made improvements to the technology, based on feedback received. ____

k) ... shared information and campaigned for support very quickly with senior management. ____

l) ... shared information and campaigned for support very quickly with team members. ____

2. Support was gained for this new technology by validating ideas outside the firm with ...

a) ... potential suppliers. ____

b) ... potential users. ____

c) ... alliance partners. ____

d) ... external financiers. ____

e) ... government contacts. ____

PART IX. Pre-development phase: What was the project market vision? **WHAT DID YOUR COMPANY'S MARKET VISION CONSIST OF? HOW CLEAR AND SUPPORTED WAS IT? (Market vision: mental image that firm members have of a desired and important market for a new technology.)**

1. In the very early stages of this technology's development, it was clear ...

a) ... what the likely product applications would be. ____

b) ... who the target market (user) would be. ____

c) ... how the product would be used. ____

d) ... what target customers' needs would be. ____

2. Even in the very early stages of development, prior to formal project status, the market vision was ...

a) ... tangible (e.g., easy to visualize). ____

b) ... clear. ____

c) ... of great magnitude (e.g., affecting many industries, markets). ____

d) ... thought to potentially have a great impact on the market. ____

e) ... important. ____

Definately Not Strongly DISAGREE			**RATING** Neutral			Definitely Yes Strongly Agree
1	2	3	4	5	6	7

Please mark **X** if not in any way applicable to you

f) ... attractive. ____

g) ... desirable. ____

h) ... representative of the organizational values. ____

i) ... felt to be of great importance to society. ____

3. Overall, the market vision for the project was supported by ...

   a) ... senior managers. ____

   b) ... team members. ____

4. The technical goals were clear to team members in the early stages. ____

5. Over time, the market vision became the guiding philosophy of the overall organization. ____

6. Over time, the market vision changed dramatically; it was not stable. ____

7. By the time the project was formalized, the market vision was very clear. ____

8. By the time the project was formalized, the market vision was shared by all team members. ____

9. This vision of how the technology would play out in the market was very different ...

   a) ... from what was currently available to the market for the same use. ____

   b) ... to other competing visions for the new technology. ____

   c) ... so different, in fact, that we knew it would require a great effort to bring it to market.

10. When we first started thinking about what specific markets would benefit from the technology, we spent most of our time thinking and talking about ...

    a) ... the technology itself. ____

    b) ... the product features and benefits that would be important to end users. ____

    c) ... the product's design (components and integration). ____

    d) ... how the end-user would ultimately interact with and use the product. ____

    e) ... how the product would fit into an overall system of use for potential customers. ____

    f) ... what the largest target market would be. ____

    g) ... what the most profitable target market would be. ____

    h) ... what the most important target market would be. ____

    i) ... being first to market. ____

Definately Not	**RATING**	Definitely Yes
Strongly DISAGREE	Neutral	Strongly Agree

1——2——3——4——5——6——7

Please mark **X** if not in any way applicable to you

PART X. Please indicate the **DEGREE OF SUCCESS,** which you feel your company has achieved **ALONG EACH OF THE FOLLOWING INDICATORS (1 = 0% success; 7 = 100% success).**

1. The degree to which ...

   a) ... products stemming from the technology provide a competitive advantage (e.g. profits). ____

   b) ... customers were satisfied. ____

   c) ... customers accepted the products stemming from the technology (even prior to sales). ____

   d) ... external sources of private financing were attracted to the project (e.g., venture capital). ____

   e) ... external sources of public financing were attracted to the project (e.g., public stock issue). ____

   f) ... the patent has been cited as compared to other industry patents. ____

PART XI

Please help me in **classifying** the company you work for and the industry you are in. Fill in the blanks or circle the appropriate answers. Please be assured that all information will be kept confidential.

1. We have a patent for the technology of interest: Yes/No
2. The average age of companies in this industry is probably _____ years and our company is _____ years.
3. We spent approx. _____ % of our sales/(of worth for new organizations) on R&D.
4. We spent approx. _____ % of our sales/(of worth for new organizations) on Marketing Expenditures.
5. We have approx. _____ (#) employees in the SBU (if relevant) and _____ (#) employees in the firm.
6. Our approximate per annum revenues are $ _____ for the SBU (if relevant) and $ _____ for the firm.
7. Business-to-Business/Consumer Product Scale: On average, where would you place the new products of your company (SBU/division)?

	RATING	All Ultimate
All B-to-B	About 50/50	Consumer

1——2——3——4——5——6——7 ____

Please mark **X** if not in any way applicable to you

Thank you for taking part in this study.

To return the survey:

by FAX: **Susan Reid**

...or...

by e-mail: **...or...**

by Mail: Susan Reid
Concordia University
John Molson School of Business
Department of Marketing
1455 de Maisonneuve Blvd. West
Montreal, CANADA H3G 1M8

Would you like a copy of the summary results of this study?
Please provide your name and address:

_____

_____

_____

_____

_____

CONTACTS: To make this study as objective and relevant as possible, please help me to contact other potential candidates; these could be managers in other divisions or SBUs in your firm, or persons in other companies who you feel can make a contribution.

_____

_____

_____

_____

_____

Appendix 2: Radical Innovation Survey

Questionnaire 2

Graduate Researcher:
Susan E. Reid
Ph.D. Candidate
Concordia University
Montreal, Canada

In this academic study, I seek to better understand how organizations link advanced technology developments with market opportunities of the future. I value your opinions and would appreciate your cooperation in filling out this questionnaire.

Your answers will remain completely confidential. All evaluations are based on averages and no individual company data will be published in any way. While you are not under any obligation to complete this questionnaire, your assistance will help academics and managers in general to better understand and better manage under conditions of radical new product development.

Some of the **benefits** you may gain from this study are:

- Data will be gathered from other companies, permitting the creation of average values. Your organization will be able to **compare your activities and results with the average values.**
- After the data is collected, a profile of "best practice" firms (top 20%) will be prepared. The results will be available to you upon request, enabling you to **compare yourself with "top" performers.**

Thank you in advance for taking part in this study. Please read the following before answering.

In this study, I am asking you to provide data about you and your company's involvement with **ONE new technology** that your company has either already developed or is in the process of developing into product(s). The technology you choose to consider in answering this questionnaire should be considered both **"high-tech"** (≥6% of sales or worth are spent on R&D) and **"radical"** ("new-to-the-world"; operationally, we can consider a radical innovation to be any one that either improves performance in the range of at least 5- to 10-times improvement or reduces costs by at least 30%).

Most questions may be answered by filling in the blank with a number that best corresponds with the scales at the top of each page. In a few instances, however, specific scales are utilized for given questions and are provided beside or underneath those questions, where applicable. Even if some questions appear similar to others, please answer them all, as this is important for my analysis. Exact answers are not necessary. Just give your best estimate. **Thank you for your assistance!**

Please, identify below the company, the division/SBU (if applicable) and your general role. This information will only be used to sort the data and will not be published or used in any other manner.

Company Name _____

Division/SBU (if applicable) _____

I was (am) a member of the team developing this technology: Yes/No

I was (am) a member of senior management: Yes/No

The ratio of my R&D/Marketing expertise could be measured as:

RATING

All R&D Neutral All Marketing

1——2——3——4——5——6——7 _____

Please mark **X** if not in any way applicable to you

Definately Not	**RATING**	Definitely Yes
Strongly DISAGREE	Neutral	Strongly Agree

1——2——3——4——5——6——7

Please mark **X** if not in any way applicable to you

PART I. Let's begin by classifying **THE TECHNOLOGY** you are discussing in this questionnaire.

1. The technology is totally "new-to-the-world". ____
2. The manufacturing process is totally "new-to-the-world". ____
3. Products from this technology (will) require a new approach to distribution. ____
4. Our company (SBU) is currently focused only on this technology. ____
5. The technology has an excellent fit with our capabilities, skills, and experience. ____
6. We had the necessary equipment in the early stages of the development of this technology. ____
7. We had the necessary financial resources in the early stages of the development of this technology. ____
8. Our firm will likely become well-known in the industry for our work with this technology. ____
9. Our firm has a good reputation in this industry for our work with this technology. ____
10. We were slow to adopt/develop this technology because ...
    a) ... it was very complex. ____
    b) ... it had a high degree of uncertainty. ____
    c) ... it required the combination of more than one scientific area of expertise. ____
    d) ... it was difficult to try out on a limited basis. ____
    e) ... the advantage of using it was not obvious. ____
11. We considered the technology risk (i.e., ability to generate products from the tech.) to be very high. ____
12. We considered the market risk to be very high. ____
13. We considered that there would be a risk in seeking the market application we were primarily interested in. ____
14. We felt that the market for this particular application was not well developed. ____

PART II. Next, let's talk about **THE COMPETITIVE ENVIRONMENT** for this **TECHNOLOGY.**

1. A large number of firms are competing with us for the same end application for this technology. ____
2. I would estimate the ratio of small to large competitors using this technology to be approximately:

All small	**RATING**	All
Companies	About 50/50	Large Companies

1——2——3——4——5——6——7 ____

Please mark **X** if not in any way applicable to you

Definately Not	**RATING**	Definitely Yes
Strongly DISAGREE	Neutral	Strongly Agree

1——2——3——4——5——6——7

Please mark **X** if not in any way applicable to you

3. Almost all firms working with this technology also participated in a previous generation of the technology. (1 = almost no firms; 7 = almost all firms) _____
4. We are using patents as a way of protecting this technology. _____
5. We have trade secrets to try to protect this technology. _____
6. We are trying to develop the industry standard as a way of protecting this technology. _____
7. We pioneered the specific application context for this technology. _____

PART III. Next, let's look at the **EXTERNAL NETWORKS** that your firm (SBU) participated in **BEFORE** this project got the green light for formal development.

1. In networking with the environment outside our firm, we gained support for this new technology by validating ideas with …
   a) ... external financiers, such as venture capitalists or bankers. _____
   b) … government officials. _____
   c) … academics. _____
   d) … individuals from other companies (e.g. from alliances; sub-contracts; consultants, etc.). _____
   e) … our more innovative (potential) customers. _____
   f) … our more innovative (potential) suppliers. _____
2. We accessed available financial resources from …
   a) ... external financiers, such as venture capitalists or bankers. _____
   b) … government. _____
   c) … academia. _____
   d) … other companies (e.g. from alliances; sub-contracts; consultants, etc.). _____
   e) … our more innovative (potential) customers. _____
   f) … our more innovative (potential) suppliers.
3. We actively recruited personnel from …
   a) ... external financiers, such as venture capitalists or bankers. _____
   b) … government. _____
   c) … academia.
   d) … other companies (e.g. from alliances; sub-contracts; consultants, etc.). _____
   e) … our more innovative (potential) customers. _____
   f) … our more innovative (potential) suppliers. _____

Definately Not	**RATING**	Definitely Yes
Strongly DISAGREE	Neutral	Strongly Agree

1——2——3——4——5——6——7

Please mark **X** if not in any way applicable to you

PART IV. What **EXTERNAL NETWORKS** did key individual(s) participate in **BEFORE** getting the green light for formal development.

1. The person who first championed this technology in our firm...

   a) ... had a broad network of relationships outside of the company. ____

   b) ... had an external network made up of people with a variety of different backgrounds. (e.g., different industries, different disciplines, different functions, etc.) ____

   c) ... was at the center of the external network growing up around the new technology. ____

   d) ... played a central role in the industry development of the technology (was a pioneer). ____

   e) ... got our company involved with "lead users" of the technology ahead of our competitors. ("lead users": anticipate and influence general needs of the marketplace months/years before others) ____

   f) ... got our company involved with lead suppliers of the technology ahead of our competitors. ____

   g) ... traveled to many conferences. ____

   h) ... had many interactions with university people. ____

PART V. HOW WERE **NEW IDEAS** promoted **INSIDE** your organization **BEFORE** this project got the green light for formal development?

1. The person who first championed this technology in our firm...

   a) ... got key decision makers in our firm involved. ____

   b) ... brought together a cross-functional team to be involved. ____

   c) ... secured the required senior management-level support. ____

   d) ... got problems into the hands of those who could solve them. ____

   e) ... shared thoughts and feelings about the way the market was going. ____

   f) ... brought together a diverse group of people internally (e.g., varying age, expertise, seniority, etc.). ____

   g) ... used politicking to get people on board (i.e. was able to motivate others to participate). ____

   h) ... shared information and campaigned for support very quickly with senior management. ____

PART VI. How did your firm **LEARN ABOUT AND INTERACT WITH POTENTIAL MARKETS BEFORE** this project got the green light for formal development?

1. We tried to keep our market opportunity options open as long as possible for the new technology. ____

2. We tried to develop several potential technology scenarios before choosing a market(s) to pursue. ____

Definately Not Strongly DISAGREE			**RATING** Neutral			Definitely Yes Strongly Agree
1	2	3	4	5	6	7

Please mark **X** if not in any way applicable to you

3. Our understanding of potential markets was updated in light of new information from forecasts. _____
4. We used several forecasting and market estimation techniques in combination before market selection. _____
5. We used a decision support system (e.g. a database) to help forecast market opportunities. _____
6. The original market we had targeted for this technology is not the market we are targeting now. _____
7. We assessed whether we needed to change our overall product strategy when this technology came along. _____
8. Co-developing products with lead users of advanced technologies helped us anticipate needs of future markets. _____
9. We helped our customers anticipate technology developments in their markets. _____
10. We tried to discover additional needs of our customers of which they are unaware. _____
11. We incorporated solutions to unarticulated customer needs in our new products and services. _____
12. We brainstormed on how customers might use our products and services. _____
13. We innovated even at the risk of making our other products obsolete. _____
14. We searched for opportunities in areas where customers have a difficult time expressing their needs. _____
15. We extrapolated key trends to gain insight into what users in a current market will need in the future. _____
16. We approached potential customers as soon as we had a prototype. _____

PART VII. What did your company's **MARKET VISION** consist of? How **CLEAR** was it?

1. In the very early stages of this technology's development, it was clear ...
   a) ... what the likely product applications would be. _____
   b) ... what the value (benefits/costs) to end users would be. _____
   c) ... what target customers' needs would be. _____
   d) ... how the product would be used. _____
   e) ... who the target market (user) would be. _____
2. Even in the very early stages of development, prior to formal project status, the market vision was ...
   a) ... clear. _____

Definately Not Strongly DISAGREE			**RATING** Neutral			Definitely Yes Strongly Agree
1	**2**	**3**	**4**	**5**	**6**	**7**

Please mark **X** if not in any way applicable to you

b) ... tangible (e.g., easy to visualize). _____

c) ... very specific. _____

d) ... able to provide direction to others in the organization. _____

e) ... thought to potentially have a great impact on the market. _____

f) ... of great magnitude (e.g., affecting many industries, market). _____

g) ... engaging (e.g., felt like a winner). _____

h) ... important. _____

i) ... attractive. _____

j) ... desirable. _____

k) ... felt to be of great importance to society. _____

3. When we first started thinking about what specific markets would benefit from the technology, we spent most of our time thinking and talking about ...

a) ... the product features and benefits that would be important to end users. _____

b) ... how the end-user would ultimately interact with and use the product. _____

c) ... how the product would fit into an overall system of use for potential customers. _____

d) ... ease of use for potential customers. _____

e) ... the product's relationship to the customer use environment. _____

f) ... the potential for scaling up. _____

g) ... the potential for standardizing the design. _____

h) ... what the mass market for the product would be. _____

i) ... delivering unique customer value (benefits/costs). _____

j) ... what the most profitable target market would be. _____

k) ... what the most important target market would be. _____

l) ... what the largest target market would be. _____

m) ... whether we would achieve market leadership status. _____

PART VIII. Please indicate the **DEGREE OF SUCCESS,** which you feel your company has achieved **(1 = 0%; 7 = 100%).**

a) Products stemming from the technology (will) provide a competitive advantage (e.g. profits). _____

b) Unique benefits: perceived as superior to competitors. _____

Definately Not	**RATING**	Definitely Yes
Strongly DISAGREE	Neutral	Strongly Agree

1——2——3——4——5——6——7

Please mark **X** if not in any way applicable to you

c) Innovation's technical quality. _____

d) Innovation's value to the organization. _____

e) Innovation's potential impact on industry. _____

f) Early customers were satisfied (even prior to sales). _____

g) Early customers accepted the products stemming from the technology (even prior to sales). _____

h) Customers' needs were (will be) satisfied better by these products than existing ones. _____

i) Average growth in company employment stemming from involvement with the technology. _____

j) Cash flow. _____

k) Ability to attract capital. _____

l) Amount of funding (internal and external) compared to initial request. _____

m) Linking the advanced technology to a good market application. _____

PART IX

If you are able to, please help me in **classifying** the company you work for and the industry you are in. Fill in the blanks or circle the appropriate answers. Please be assured that all information will be kept confidential.

1. The average age of companies in this industry is probably _____ years and our company is _____ years.
2. We have a patent for the technology of interest: Yes/No

   If no, why not (if reason known): _____

   _____

   _____
3. Please list your licensed or patented product(s) or process(es) (if known):

	Patents	Licenses Granted	Licenses Received
Number			
Years			
Countries			

4. Main Products Offered and Researched:

Product Name	Product Description	Years of Development	Year Launched	Geographic Markets Targeted	% Revenues

5. Basic Company Statistics (Total) (Estimates are fine):

	# Employees	Revenues (Sales)	% R&D/Sales	% Marketing Expenditures/Sales
1998				
2000				
2002				

Thank you for taking part in this study.

To return the survey:

by fax: [illegible]

...or...

by e-mail:

...or...

by mail: Susan Reid
Concordia University
John Molson School of Business
Department of Marketing
1455 de Maisonneuve Blvd. West
Montreal, CANADA H3G 1M8

Would you like a copy of the summary results of this study?
Please provide your name and address:

_____

_____

_____