An Examination into Technological Timing Efforts: The Performance of Firms in the Personal Computer Industry

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ABSTRACT

This study investigates how firms navigate technological changes over time. Specifically, we determine whether firms follow a consistent strategy in regards to when they time their entry into technological waves. Resulting performance implications of these actions are also measured. The theoretical underpinnings of this study lie at the intersection of the technology literature, the learning school, firm evolutionary theory, and the resource-based view of the firm. Past studies have added clarity as to how firms behave within a single technological wave; however, investigations regarding firm actions over successive waves are needed if we are to truly understand which firm actions lead to long-term success.

This study fills the research gap by investigating firm timing patterns over multiple successive waves of technology and the resulting long-term performance implications of these actions. Further, this study examines timing efforts over both competence enhancing (incremental) and competence destroying (architectural) cycles. The findings indicate that while technological follower firms are able to consistently repeat their timing strategy, technological leaders have a much more difficult time in repeating early entry timing. Repeated leadership entry was found to be difficult in both incremental and architectural cycles. Characteristics of those leaders able to repeat leadership entry are provided.

While consistent entry timing was not found to impact market share, it was found to benefit firms by reducing their hazard rate. This hazard rate reduction for timing entry consistency, whether it is as a leader or as a follower, was observed during both incremental and architectural technological changes.

Dedication

Dedicated to my wife Catherine:

whose love, support, and patience

made it all possible.

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My completion of this dissertation would have been impossible if not for the help of several people. First, I would like to thank my co-chairs, Drs. Linda Tegarden and Donald Hatfield. Thank you, Linda, for allowing me access to the data I used in this study. Linda worked tirelessly to guide me through the dissertation process: always there to provide support when I needed it and a good kick when needed as well. I cannot thank Linda enough. Don selflessly gave up his time to listen to my ideas and to stimulate my intellectual curiosity. Don showed great empathy during this process and his encouragement will not be forgotten. Both Linda and Don served as excellent role models and mentors during my time at Virginia Tech.

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1.0 INTRODUCTION

> "The fundamental impulse, that sets and keeps the capitalist engine in motion comes from the new consumers' goods, the new methods of production or transportation, the new markets...[This process] incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact about capitalism",
>
> *Schumpeter (Capitalism, Socialism & Democracy 1942, p.83)*

Schumpeter's writings can be seen as warning to firms that there will be "new goods, new methods, and new markets." The danger of these events is that firms may not know when or how to adequately respond to industry technological changes as they occur. It is thought that technological changes occur in waves representing constant and repeated innovations and imitations (Christensen, 1992; Nelson & Winter, 1982). Firm responses to these waves can either be to pursue innovation or imitation strategies (Porter, 1985a). Firms that pursue innovations generally time their entry into these cycles earlier than those firms attempting imitation in order to capture any benefits that may be afforded to early movers (Abernathy & Utterback, 1978; Leiberman & Montgomery, 1988).

Choosing only one of these strategies is believed to be crucial to firm survivability as firms are capable of making investments in only a finite spectrum of resources (Barney, 1986). Therefore, firms must choose carefully which and when to engage in unique behaviors (Dosi, Nelson, & Winter, 2000). Although no market is perfectly competitive (E.g. government influences or luck may lead to inefficiencies), competitive markets mostly determine which firms to retain based on the success of their offerings. Successful firm technological choices, therefore, can be measured not only by the financial returns generated by firms but by their very existence in future industry offerings.

Complicating the management innovation strategy decision is evidence that in order to succeed through multiple waves of technology, a firm must constantly build and deploy the resources required to be successful. The acquisition and deployment resource decisions made by management define the firm's capabilities (Eisenhardt & Martin, 2000; Teece, Pisano, & Shuen, 1997). Abernathy and Utterback (1978) indicate that the "character" of a firm's innovation must change over time to recognize the changing needs of the innovation effort. The authors propose that firms must alter their orientations as a technology matures to focus more on the processes necessary to meet the needs of a growing market and allocate fewer resources to product innovation. In this view, firm management would realize the proper time to switch orientations between product and process innovations and be equally skilled at both processes. Adeptly timing these capability changes would be the ideal, as the firm would be able to obtain the benefits of its innovations while exploiting its learning through building scale sufficient to satisfy a growing market (March, 1991). Further, as postulated by Schumpeter, the winds of creative destruction will blow, forcing firms to make decisions as to when to leave the comfort and security of its current technological trajectory for the uncertainty of a new innovation (Barnett, 1995; Leonard-Barton, 1988; Meeus & Oerlemans, 2000).

However, a firm's ability to change its strategic orientation at will is in question due to inertial forces from prior decisions (Hannan & Freeman, 1984;

Leonard-Barton, 1992). Further, it may be unwise for a firm to move away from the elements which define the firm and what it does best, as it is these unique capabilities that allow firms to exceed the performance of other firms (Peters & Waterman, 1981; Prahalad & Hamel 1990).

1.1 Purpose of Study

The purpose of this study is to research the consistency of firm entry timing patterns and the outcomes that result from such chosen actions. Firms can generally pursue one of two timing strategies, entering as a leader in a new technological regime or entering as a follower. Leaders in technological regimes include those firms that enter new technological cycles prior to the advent of a dominant design. In some instances, the creator or inventor of a technology is also the firm that brings the technology to market, but this does not have to be the case as innovations can be created by one firm but successfully marketed by another (Christensen, 1992; Golder & Tellis, 1993; Teece, 1986). Thus, leaders do not necessarily equate to first movers, although they may be. Followers allow the market and industry participants to declare a winner in the battle over a dominant design and enter only after a technology has been chosen as a winner. Followers tend to be those firms adept at absorbing new linkages between components and manufacturing, allowing them to successfully market the new technology effectively and efficiently.

Unclear at this point is whether or not firms follow defacto innovation strategies, in that leaders tend to remain leaders and followers tend to remain followers. If the capabilities that allow firms to innovate differ from those resources that make it possible for firms to absorb new offerings, we would expect for firms to consistently time their entry into technological cycles either before the dominant design is settled upon, or afterwards, depending on which capabilities have been honed by the firm in question. However, if firms are able to acquire and deploy both sets of competencies: those that allow for innovation as well as absorption, we would not expect a firm to have to choose one set of resources or the other and would therefore excel at all points of a technological evolution (Tushman & O' Reilly, 1996). In this scenario, we would not be able to identify consistent entry timing actions.

In this study, the pathway envisioned is one in which consistent successive timing actions reinforce the firm's core competencies. These strengthening of firm capabilities then lead to positive firm outcomes (see Figure 1.1: Proposed Model). Firm actions in the form of resource building may lead the firm to time its entry early in a technological cycle (technological leadership), or to time its entry later in the technological cycle (technological followership). It is suggested that either timing strategy, pursued consistently, may lead to positive performance implications for the firm. However, mixed entrances, or inconsistent entry timing patterns are suggested to lead to negative performance implications. Performance will be examined as both market share and the hazard rate (probability of failure) the firm experiences as a result of their timing efforts.

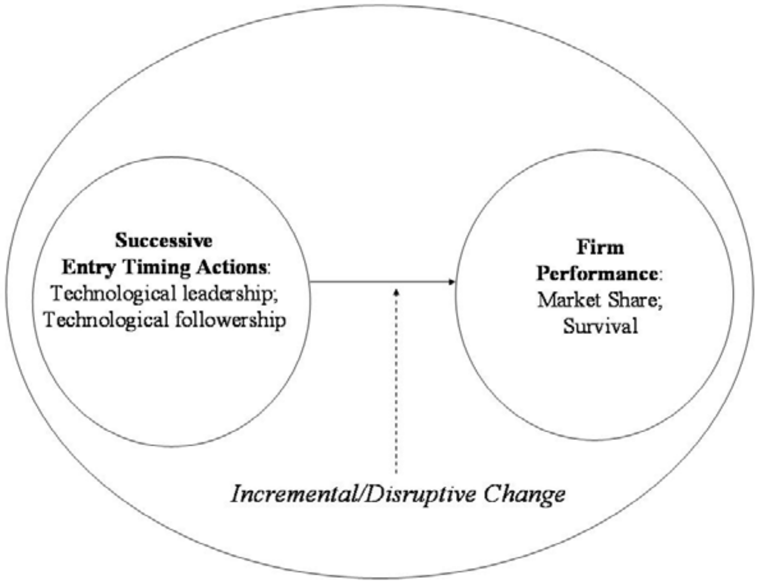


Figure 1.1. Proposed Model.

Generally, industry participants face *incremental* changes to technological offerings which have the effect of reinforcing and building on the current understandings and competencies possessed by industry participants. However, it is believed that new ways of ordering existing knowledge will evolve that cause existing knowledge structures in firms to become obsolete: creating *architectural* changes that lead to disruption of the established power structure of the industry (Christensen, 1992). Therefore, the effects of the technological entry strategies will be tested in times of incremental change as well as architectural change.

1.2 Research Questions

This research study will investigate the timing actions firms make in efforts to navigate multiple technological waves and the implications of those actions. In particular, the answers to the following questions are sought.

RQ1: Does engaging in certain initial timing strategies make firms more likely to follow similar timing strategies in the future?

Firm management must carefully choose the environment in which they participate (Child, 1972). The choice of environment should be one that allows the firm to capitalize upon the resource investments it has made or plans to make. Firms acquire or build resources over time with the expectation that the investments made into those resources (time value adjusted) will be lower than the returns they generate (Barney, 1986; Peteraf, 1993). The acquisition and deployment of idiosyncratic resources has been theorized to be the main contributor to firm profitability and the firm can only adjust as far as its investments in resources will allow (Penrose, 1959; Teece & Pisano, 1998). Further, past research indicates that different resources are needed at different periods of a technological wave if a firm is to be "fit" in its environment (Utterback & Abernathy, 1975).

Early in a product life cycle, termed the preparadigmatic stage by Abernathy and Utterback (1978), "fit" firms are those that pursue the creation of product innovation (Utterback, 1994). Those firms that enter during preparadigmatic stage, the technological leaders, would be those firms that are skilled in new product development (Lieberman & Montgomery, 1988). Firms competing in this period would be those as described by Abernathy and Utterback's (1978) fluid pattern of operation. Common during this period is firms utilizing inefficient general purpose equipment to produce functional products that frequently change to reflect the fluid desires of lead users (the early adopters of innovations). Organizational controls are generally informal and entrepreneurial during these early stages of innovation.

Studies have shown that for most innovation trajectories, variable innovative efforts will be whittled down to one dominant design (Anderson & Tushman, 1990; Christensen, Suarez, & Utterback, 1998; Suarez & Utterback, 1995). The selection of the dominant design has been viewed as a catalyst for firms to accumulate assets intended to achieve economies of scale and to erect barriers to entry (Suarez & Utterback, 1995). Termed the paradigmatic stage by Abernathy and Utterback (1978), this period of operation is much more closely aligned to Chandler's (1990) description of the managerial enterprise: where firms invest in management, production, and distribution systems in order to achieve economies of scale and/or scope and benefit from the learning curve. The inability of firms to manage production after the advent of a dominant design is a major cause of firm failure (Utterback & Suarez, 1993); therefore, achieving cost reductions and effectively competing, either through marketing and manufacturing, is key to competing effectively during this later stage (Lieberman & Montgomery, 1988; Robinson, Fornell, & Sullivan, 1992).

Based on the logic provided, the resources that allow a firm to succeed in one era of innovation, either early or later in the technological cycle, are not necessarily those that allow success during the other. Further, the building of internal operations and procedures may lead firms to be able to handle one type of environmental frontier at the expense of meeting the needs of others (Hannan & Freeman, 1984). Moore, Boulding, and Goodstein (1991) contend that firm management consciously chooses when a firm will time its entry into a technological cycle. In anticipation of future timing decisions, firms must build resources over time. Firms have limited resources and must therefore carefully "pick their battles," making it likely those firms will choose to align their resources and timing strategies. Specifically, we would expect that:

Proposition 1a: Leaders are more likely to be leaders again when facing successive incremental innovation cycle changes.

Proposition 1b: Followers are more likely to be followers again when facing successive incremental innovation cycle changes.

The way that firms do or do not respond to change has been studied to some length by management researchers. Views regarding a firm's ability to change vary. For example, whereas the population ecologist believes that change for firms is extremely difficult due to structural inertia (Hannan & Freeman, 1984), the learning school sees firms as possessing more absorptive capacity (Cohen & Levinthal, 1990).

While many categorizations of change have been used, Henderson and Clark (1990) present one of the most frequently used classification schemes for the changes resulting from innovation (See Figure 1.2: Innovation Framework). According to the authors, innovation change can be described as a continuum ranging from incremental to radical in nature. While incremental changes rarely negatively impact incumbent firms, instead reinforcing existing industry structures, radical technological changes can be detrimental to incumbent firms (Mitchell, 1989). Radical technologies represent major scientific breakthroughs or innovations which create a new market (Dess & Beard, 1984; Dewar & Dutton, 1986; Tripsas, 1997). Dosi's definition of a radical technology, which has been frequently used in the study of technological innovations, is that it "redefines the very meaning of progress" (Dosi, 1982; Lawless & Anderson, 1996).

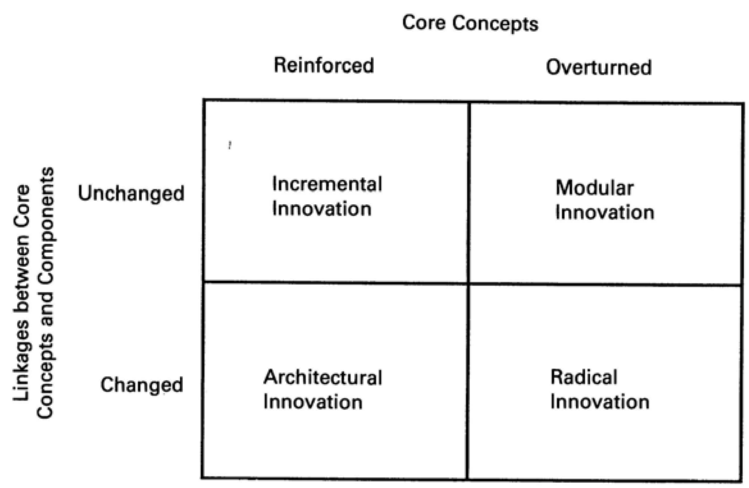


Figure 1.2. Innovation Framework (Henderson & Clark, 1990, p.12). Reprinted from "Architectural Innovation - the Reconfiguration of Existing Product Technologies and the Failure of Established Firms" by R. M. Henderson & K. B. Clark. Published in *Administrative Science Quarterly, 35*(1), p. 12 by permission of *Administrative Science Quarterly.* ©

Henderson and Clark (1990) suggest that to uncover the underlying reasons firms do not manage radical change well, researchers should distinguish between the components of the product, which are generally easily understood by firms, and the ways these components are integrated into the system: the product architecture. Architectural innovations are those innovations "that change the way in which the components of a product are linked together, while leaving the core design concepts untouched" (Henderson & Clark, 1990, p. 10). The knowledge structure possessed by firms will become engrained in terms of structure and processes as the firm develops experiences with a class of innovation. As a result, firm capabilities around a core set of capabilities will be enhanced, allowing for greater abilities in incremental improvements to the known innovation (Thomas, 1995). However, through internalizing knowledge adjustments to new architectures, or ways through which the components are linked, may be difficult, if not impossible for the incumbent firm to manage (Leonard-Barton, 1992).

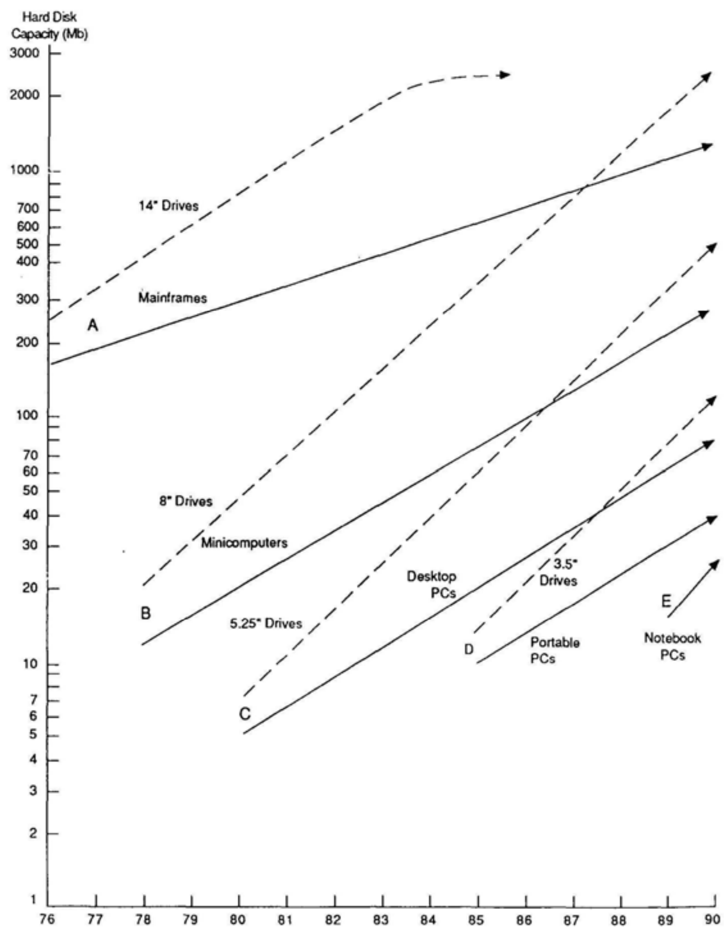


Figure 1.3. Innovation Trajectory Comparisons. Reprinted from *Research Policy 24(2)*. C. M. Christensen & R. Rosenbloom, “Explaining the Attacker's Advantage: Technological Paradigms, Organizational Dynamics and the Value Network,” pp. 233-257, 1995, with permission from Elsevier.

In addition to the difficulties firms will encounter in meeting the needs of a new product architecture, Christensen and Bower (1996) suggest a resource dependence view to explain why incumbents have a difficult time adjusting to disruptive innovations. Christensen and Bower point out that early variations of new offerings are often unable to match existing technologies in terms of the product attributes customers value (See Figure 1.3: Innovation Trajectory Comparison). Further, in many cases the new technology would require changes to the larger systems in which they are subcomponents as technologies are often nested within larger technological systems (Afuah, 1998; See Christensen & Rosenbloom (1995) Figure 1.4: Nested Hierarchy of Technologies). The established customer base will, therefore, have little reason to want existing producer firms to switch to the new innovation in its early form.

Furthermore, from an internal resource perspective, proponents within the firm of the incumbent technology battle for resources which could be used for the development of the new technology. Insecurities and power plays within the firm can quickly derail development efforts for the new innovation. As a result, incumbent firms supplying incumbent technologies ignore or fail to develop new technologies. Over time, "disruptive technologies" will match previous technologies in terms of basic product attributes and excel on tangent dimensions which will make their use even more attractive to customers using the previous technology. When this happens, customers will switch to the new technology, leaving the supplier still specializing on the previous technology in a diminishing market space.

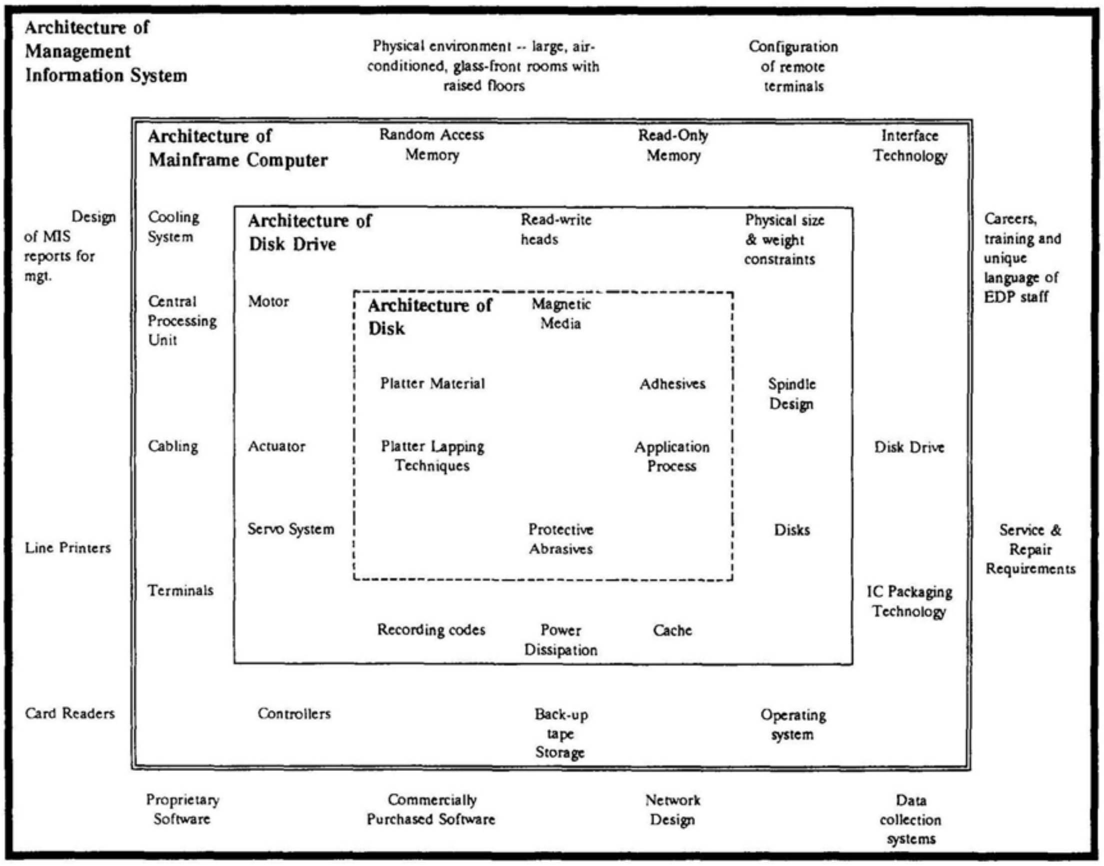


Figure 1.4. Nested Hierarchy of Technologies. Reprinted from *Research Policy 24(2)*. C. M. Christensen & R. Rosenbloom, “Explaining the Attacker's Advantage: Technological Paradigms, Organizational Dynamics and the Value Network,” pp. 233-257, 1995, with permission from Elsevier.

For firms that wait to enter the technological trajectory, the technological followers, a different set of difficulties present themselves. Researchers have theorized that followers tend to focus on incremental innovations, relying on their ability to obtain economies and present a wide assortment of products to increase the value provided to customers (Ali, 1994; Lieberman & Montgomery, 1988; Porter, 1985a). However, innovation returns are scarce during the later stages of an innovation as the underlying knowledge switches from architectural to incremental in nature. Incremental innovations are based on known architectures and do not have the same isolating effect as does the creation of base architectural innovations (Zander & Kogut, 1995). Therefore, firm manufacturing and marketing abilities may offer a better platform for firm survivability and heterogeneity (Chandler, 1990; Robinson, Fornell, & Sullivan, 1992).

As presented in the preceding, we can expect innovation leader firm's knowledge structures to strengthen and solidify over the life of a technology. This in-depth knowledge will serve the leader well against competitors as knowledge is diffused through an industry: forcing the innovation leader to derive value in the creation of incremental improvements to the existing technological architecture. However, inflexible resource factors will be a hindrance to the firm's ability to recognize and adjust to architectural technological changes.

Conversely, firms that consistently enter new technological cycles as followers have been theorized to be more skilled than the early entrants in terms of manufacturing and marketing (Lieberman & Montgomery, 1998; Robinson, Fornell, & Sullivan, 1992). Manufacturing and marketing skills represent requisite firm skill sets needed by firms attempting to capitalize from innovation changes (Abernathy & Utterback, 1978; Teece, 1986; Tripsas, 1997. See Figure 5: Complementary Assets Needed to Commercialize Innovations). With a complete array of complementary assets, these followers can more successfully survive multiple innovation changes, whether they be incremental or architectural.

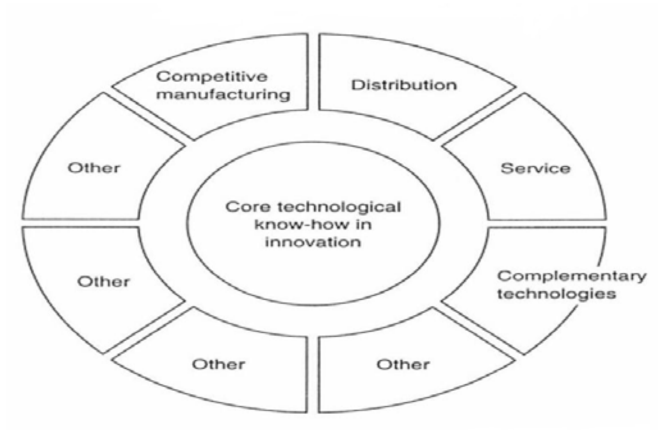


Figure 1.5. Complementary Assets Needed to Commercialize Innovations. Reprinted from *Research Policy 15(6)*. D. J. Teece, "Profiting From Technological Innovation - Implications for Integration, Collaboration, Licensing and Public-Policy," pp. 285-305, 1986, with permission from Elsevier.

With these factors in mind, the following statements are proposed:

Proposition 1c: Leaders are less likely to be leaders again when facing architectural innovation cycle changes.

Proposition 1d: Followers are more likely to be followers again when facing architectural innovation cycle changes.

RQ2: Do consistent firm timing strategies affect firm performance?

Should innovation leaders continue to be innovation leaders or innovation followers continue to be followers, a number of positive results can be expected. Within the firm, management can continue to build upon existing skill sets, thus further enhancing existing competencies. The strengthening of proven competencies during periods of incremental change should allow the firm to continue to improve upon successful offerings. Through continually improving its offerings, the firm can meet needs demanded by its customers and maintain market share leads over later entrants (Robinson, Kalyanaram, & Urban, 1994).

Conversely, the switching of innovation strategies may harm the firm. For example, should an innovation leader becomes an innovation follower, or if a follower attempts to become a leader in succeeding cycles, internal skill sets may be ill-equipped to make the adjustment from innovation leader to follower, or vice-versa. The two strategies require different skills and processes: early entrants relying on research and development, while later entrants rely on manufacturing and marketing skills (Lambkin & Day, 1989; Lilien & Yoon, 1990: Porter, 1980). Also, political infighting and pressures may create frictions within the firm which can reduce its ability to meet customer needs. Finally, external constituents (E.g. customers and suppliers) may be confused with the change in strategy and either not be able to meet the firm's supply needs or not purchase the firms products. Investors may not possess the same level of confidence in unproven territories, and thus public firms risk losing investment dollars. Given these factors, along with those discussed in research question 1, we would expect:

Proposition 2a: Leaders that repeat as leaders will realize better performance than those leaders that switch to follower patterns during incremental technological changes.

Proposition 2b: Followers that repeat as followers will realize better performance than those followers that switch to leader patterns during incremental technological changes.

Proposition 2c: Leaders that repeat as leaders will realize poorer performance than those leaders that switch to follower patterns when faced with architectural technological changes.

Proposition 2d: Followers that repeat as followers will realize better performance than those followers that switch to leader patterns when faced with architectural technological changes.

1.3 Overarching Framework and Theory

Management research has been described as a fish-scale science, in that multiple perspectives from various base disciplines such as economics and psychology have been employed to seek answers to phenomena under study (Baum & Rao, 1998). As an evolving field, management researchers have blended various theoretical perspectives in an attempt to come closer to the "truth" of science of management (Mintzberg, Ahlstrand, & Lampel, 1998).

This study builds on four pillars of management strategy literature: evolutionary economics, the resource-based view of the firm, organization learning, and technology and innovation management (See Figure 1.6: Theoretical Underpinnings). In reality, each of these base disciplines has come to be synthesized into a tool to better understand the relationship between firms and technology. Through the synthesis of these paradigms, a more complete picture can be formed showing how firms, technology, and the environment interact.

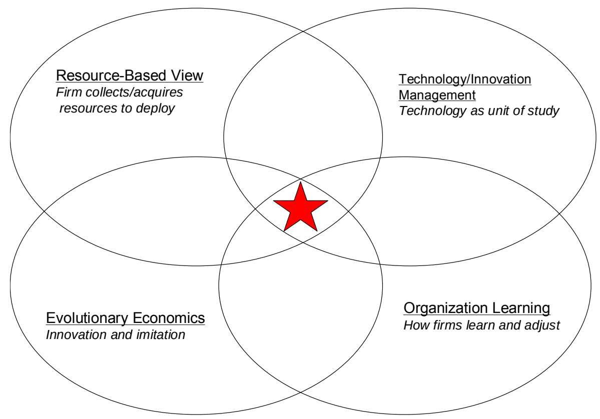


Figure 1.6. Theoretical Underpinnings.

Investigations into the management of technology and innovation (TIM) generally focus on a technological artifact as their unit of study. This field attempts to show, among other things, the nature of technological and innovation changes as technologies evolve over time. Examples of TIM literature include the works of Abernathy and Utterback (1978) and Gort and Klepper (1982). Due to the researchers' use of a technology as the unit of analysis, the sociological and political dimensions are often ignored in studies of technology and innovation. These shortcomings are often cited by critics who feel that this perspective is too simplistic in evaluating the drivers of innovation change. Critics have called for more fine-grained analysis of the causes of organizational constraints and the impact technological changes have on industry conditions (McGahan, Argyres, & Baum, 2004). These two concerns are better studied through other lenses.

Evolutionary economics may fill the gap created by the innovation and technology studies work regarding how technology impacts firms at an industry level. Stemming from natural science studies examining biological competition, evolutionary economics examines industry through the lens of economic competition. The evolutionary economist views firms as unique in that each is the possessor of heterogeneous resources (Nelson & Winter, 1982). In addition, each firm possesses elements of continuity and may only change within limits. These resources are deployed to create innovations which are imitated by competitors. Because each firm is unique, imitation is never precise and the market chooses and rewards the version most favored. Lacking in the evolutionary economist accounts, however, is a clear understanding of firm resources.

Firm resources are best understood from the perspective of the resource-based view of the firm. To the resource-based theorist, it is firm resources, whether financial, human, or organizational, obtained through acquisition or nurture, which makes each firm unique (Wernerfelt, 1984; Barney, 1991). These heterogeneous attributes lead to firm above average profitability (Wernerfelt, 1984). The resource-based view complements evolutionary theory in that evolutionary theory states that firms are heterogeneous but never provides details as to the factors that create these differences. However, the resource-based view suffers by not providing explicit instructions to managers as to what resources to stockpile in order to be successful. Managers are left wondering how the acquisition of one resource over another make a difference?

The learning school supplements the resource-based view by helping firm management determine how to create and deploy resources for future successes. Therefore, the learning school provides the prescriptive power missing by the resource-based view of the firm. The learning school of thought suggests that firms are capable of change. Further, it views the firm as a collection of individuals, who, in turn, are repositories of knowledge. It is this collective knowledge that is shared and focused towards the solving of problems. Quinn (1978) felt that decisions made by firm members were targeted to overall firm improvements creating a type of “logical incrementalism.” This logical incrementalism fits nicely with Nelson and Winter’s (1982) evolutionary account of the ability of firms to evolve routines to meet challenges created by changes in the environment.

1.4 Outline of this Study

This study will proceed in the following manner. Chapter Two will present a review of the technology and innovation management, evolutionary economics, resources-based view, and learning literatures. The hypotheses to be tested will be presented in Chapter Three. In Chapter Four, the data and variables will be presented, with the statistical testing of these variables contained in Chapter Five. Finally, Chapter Six will discuss the findings along with conclusions.

2.0 LITERATURE REVIEW

Omnia mutantur, nos et mutamur in illis
(All things change, and we change with them).
Matthias Borbonius: *Deliciæ Poetarum Germanorum, i. 685.*
John Bartlett (1919)

All things may indeed change. And yes, we at times change with them. Uncertain, however, is how change affects and influences the actions of people collectively banded together in organizations. How well firms respond to change is questionable as some researchers contend that organizational systems are not very well suited to learning new ways of accomplishing engrained behaviors and norms (Argyris & Schon, 1978; Leonard-Barton, 1992).

While many definitions of innovation have been formulated, for the purposes of this study innovation will be considered "a new idea, which may be a recombination of old ideas, a scheme that challenges the present order, a formula, or a unique approach which is perceived as new by the individuals involved" (Van de Ven, 1986, pg. 591). Included in this definition are the changes to product and structure made by firms as a result of changing technological conditions. Technology can be defined as "Those tools, devices, and knowledge that mediate between inputs and outputs (process technology) and/or that create new products or services (product technology)" (Rosenberg, 1972).

More and more, management scientists are viewing their field of study as one that requires the researcher to consider multiple perspectives in order to come to a more complete understanding of phenomena in question. Baum, et al. (1998) suggest that while some may take a dire view of multiple perspectives being championed by researchers, the reality is that the discipline of management is actually healthy in that the multiple perspectives are really fish-scales which are based on core root disciplines. Each of these fish scales aids our understanding of the science of management, and when combined, help to build more complete pictures of the discipline (Ireland & Hitt, 1997).

With the preceding views in mind, and in order to form a more complete picture of firm timing strategies, this paper will examine four different interlocking perspectives. These perspectives are technology and innovation management, organizational ecology, the resource-based view of the firm, and the learning school. Each of these theoretical bases will be synthesized into a tool to better understand the relationship between firms and technology. Through the synthesis of these paradigms, a more complete picture of how firms, technology, and the environment interact can be uncovered. The foundations for each position will be laid out along with its contribution to understanding the timing decisions of firms in the context of technological cycles.

2.1 Technology and Innovation Management

One of the earliest areas of management study is the study of technology and innovation management (TIM). Research in this area generally holds the technology or product as the unit of study and attempts to show, among other things, the opportunities or constraints created by technology and innovation advances.

Rogers (1962) built upon rural sociology research in examining the entry timing of farmers’ use of hybrid corn seeds in Iowa (Ryan & Gross, 1943). Rogers’ framework examined the penetration of innovations over time, noting that the total consumption of an innovation generally followed an s-shaped curve[1]. He identified distinct stages, from a consumer perspective, through which innovations pass (knowledge, persuasion, decision, implementation, and confirmation), factors that affect the rate of adoption (relative advantage, compatibility, complexity, trialability, and observability), and the characteristics of adopters (innovators, early adopters, early majority, late majority, and laggards).

Extending Rogers' work, Moore (1991) posited that different adopter groups possess different needs which must be met by firms. While Rogers' work is descriptive in nature, Moore presents a prescriptive account of how firms must develop and integrate different capabilities depending on ascension to anticipated stages as detailed by Rogers. For example, a firm that is participating in the innovative, early adaptor stage should anticipate that much different demands will be placed on the firm by customers when it enters the early majority or mass market stage. According to Moore, the need to switch competencies represents a chasm that firms must cross. If unable to acquire the required skill sets, the firm will fall into the chasm and fail (See Figure 2.1: The Chasm).

[1] An even earlier study of diffusion studies is attributed to Gabriel Tarde (1903) who commented that it seemed that the imitation (Tarde's term for adoption) of innovations followed an S-shaped curve.

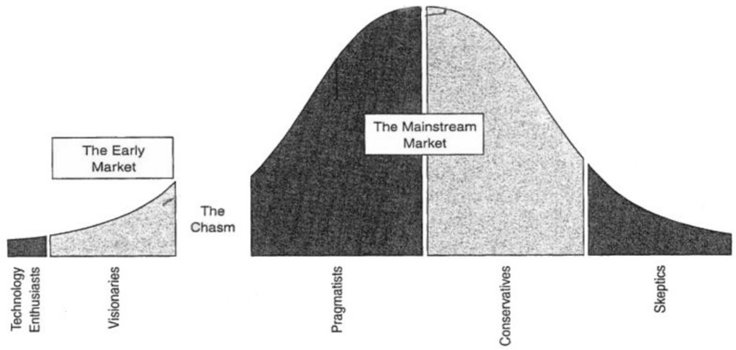


Figure 2.1. The Chasm. Reprinted from Burgelman, et al. *Strategic Management of Technology and Innovation, 3rd Edition.* “Crossing the Chasm-and Beyond” by G. A. Moore, 2001, p. 269). Used with permission granted by the McGraw-Hill Companies, Inc.

Building upon their breakthrough 1975 empirical study of industry evolution, Abernathy and Utterback (1978) provided context to Rogers’ framework through the authors’ study of the automobile industry. Abernathy and Utterback found that firms must alter their orientations to focus more on the internal processes necessary to meet the needs of a growing market and allocate fewer resources to product innovation for an innovation as consumer adoption of that innovation progresses. In essence, the authors found that process innovation, those innovation efforts aimed at the improvement of manufacturing and distribution, takes precedent over product innovation, which focuses on ways and techniques to incrementally improve upon the existing technology, as the firm progresses with the development of an innovation.

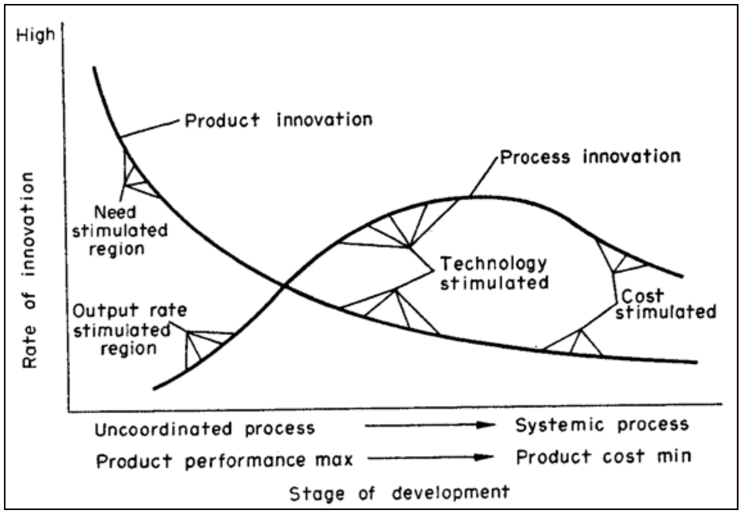


Figure 2.2. Innovation Evolution. Reprinted from *Omega 3(6)*. J. M. Utterback & W. J. Abernathy, “A Dynamic Model of Process and Product Production,” pp. 639-656, 1975, with permission from Elsevier.

Utterback and Abernathy’s contribution is a detailed examination of the stages firms pass through during an innovation life cycle (see Figure 2.2: Innovation Evolution). They indicate that firms pass through three stages as they evolve from innovation efforts focusing on product to innovation focusing on process. The authors theorized that the firm first engages in a “fluid phase,” moves through a “transitional phase,” and finally ends up in a “specific phase.” This progression is thought to be a natural process as firms over time invest in specialized assets and relationships designed to enhance their ability to produce the product more efficiently, thus meeting the growing demand needs of different adopters. Compatible with these findings, Abell (1978, p. 24) states “the “resource requirements” for success in a business-whether these be financial requirements, marketing requirements, engineering requirements, or whatever-may change radically with market evolution.”

Foster (1986b) extends Utterback and Abernathy's work by citing two main reasons for the need by firms to switch innovation focus as technologies evolve. The first is that as market demand for a product expands, the firm must create ways to meet that demand-both in terms of quantity and quality-generating the need for the process innovation. The second is that the level of performance improvement for any innovation declines over time as the technology approaches its "technical potential." With fewer performance gains available, firms will seek to maximize returns through investments in process innovations.

It is important to note that firm evolution from product innovation to process innovation should be viewed as a continuum instead of an either/or proposition. Examining Utterback and Abernathy's Industry Evolution figure, product innovation clearly never fully dissipates. Contrarily, firm knowledge of the underlying principles behind the architecture of an innovation coupled with ties with end users can lead to great successes for firms in terms of incremental improvements to innovation offerings (Sahal, 1981; Thomas, 1995; Thomas, 1996; Tushman & Anderson, 1996). Further, process innovations are possible early in the product cycle, as studies have indicated that production improvements are visible well before the establishment of a single standard (Klepper & Simons, 1993).

Firm survival, however, is not simply a matter of evolving with and developing a single new technology. No technology can be studied in isolation because history demonstrates that technologies are constantly being replaced by new innovations. For this reason, it is better to visualize "industries as evolving through successions of technology cycles" creating destruction, to previous technological cycles (Anderson & Tushman, 1991, p. 26; See Christensen (1992) Figure 2.3: Waves of Technological Cycles). The initial stages of a breakthrough technological cycle create what is known as technological discontinuities. According to Foster (1986b):

> *Technological discontinuities are among the most disruptive challenges facing corporations...it appears that few corporations are able to survive discontinuities…Despite the importance of the discontinuity problem for top management, few have done much to better anticipate and deal with these increasingly frequent events. (p. 215)*

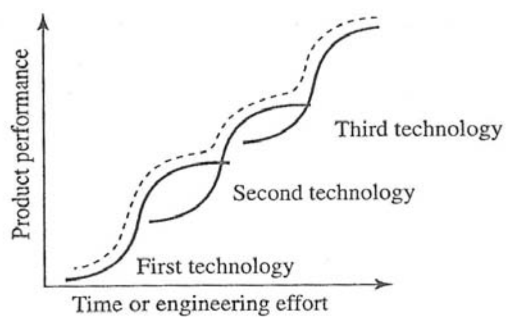


Figure 2.3. Waves of Technological Cycles (Christensen, 1992, p. 340).
Reprinted with permission from Production and Operations Management Society.

Technology and innovation management, as it relates to innovation studies, has generally revolved around finding key or unique occurrences that repeat themselves over different industries and times. Where Abernathy and Utterback identified three distinct periods in an innovation life cycle, Gort and Klepper (1982) identify five. Common features within the technology and innovation literature include the idea that most successful innovation cycles eventually lead up to the establishment of a dominant design (Tushman & Murmann, 1998). Utterback and Suarez (1993) posit that dominant designs are essentially compromises of competing technological components: a “fortunate combination of technological, economic, and organizational factors" (Suarez & Utterback, 1995, pp. 416-417). Anderson and Tushman (1990) suggest that in addition to the technical attributes of an innovation chosen as a dominant design, the sociopolitical and institutional processes, driven through an evolutionary process, have a hand in deciding which technological platform will become the dominant design. While most successful innovation trajectories develop a dominant design, this is not always the case. According to Tushman and Murmann (1998), when markets are small, or if customer preferences change often, or if government actions create barriers, two or more technological platforms may share dominant design status.

Timing relative to the dominant design has been identified to be key for firms in terms of profitability and survivability (Mitchell, 1989, 1991; Tegarden, Hatfield, & Echols, 1999). In terms of new entrants, firms with related research and development experience have been found to be more successful when timing their entry into a technological cycle early (Klepper & Simons, 2000). Klepper and Simons (2000) also found that larger firms tend to be better suited to survive the evolution of a technological cycle than smaller firms due to a larger base to which research costs can be dispersed. Klepper and Simons theorized that the type of technology, whether simple of complex, may moderate the success of entrants with prior experience. For simple technologies, such as laser technology, which require little engineering skills and are finding multiple applications, the hazard rate for smaller entrants may be lower.

In summation of the TIM literature, Klepper (1996) identifies six common themes regarding technology change. These themes were derived by Klepper from his earlier works (Gort & Klepper, 1982; Klepper & Graddy, 1990; and Klepper & Simons, 1993), along with the works of Abernathy (1978) and Abernathy, Clark, and Kantrow's (1983) studies of automobiles; Klein's study of automobiles and aircraft (1977); Tilton (1971) and Kraus' (1973) studies of transistors; Flamm (1988) and Anderson and Tushman's (1990) study of computers; A. Bright (1949) and J. Bright's (1958) studies of light bulbs; Prusa and Schmitz's (1991) study of personal computer (PC) software; Abernathy and Utterback (1978) and Utterback and Suarez's (1993) studies of multiple products (Klepper, 1996, p. 564). These commonalities include:

> 1. *At the beginning of the industry, the number of entrants may rise over time or it may attain a peak at the start of the industry and decline over time, but in both case the number of new entrants eventually becomes small.*
> 2. *The number of producers grows initially and then reaches a peak, after which it declines steadily despite continued growth in industry output.*
> 3. *Eventually the rate of change of the market shares of the largest firms declines and the leadership of the industry stabilizes.*
> 4. *The diversity of competing versions of the product and the number of major product innovations tend to reach a peak during the growth in the number of producers and then fall over time.*
> 5. *Over time, producers devote increasing effort to process relative to product innovation.*
> 6. *During the period of growth in the number of producers, the most recent entrants account for a disproportionate share of product innovations.* (Klepper, 1996, pp. 564-565)

Critics of the works within the technology and innovation perspective point out that the framework is often too simplistic in its evaluation of the drivers of change. Further, critics have called for more fine-grained analysis of the causes of organizational constraints and the impact technological changes have on industry conditions (McGahan, Argyres, & Bam, 2004). These two concerns are better studied through the framework of other theories.

2.2 Evolutionary Economics

Evolutionary economics may fill the gap created by technology and innovation management studies regarding how firms interact with technological changes. Where technology and innovation studies literature generally hold the technology as its object of study, evolutionary economics has the firm as its target. Stemming from natural science studies examining biological competition, evolutionary economics observes firms and industries through the lens of economic competition. The evolutionary economist views firms as unique in that each is the possessor of heterogeneous resources (Nelson & Winter, 1982). These resources are deployed to create innovations, achievable only in small increments, which get imitated by competitors. Because each firm is unique, imitation is never precise and the market chooses and rewards the version most favored.

Nelson and Winter viewed the firm as a series of connected routines. Firms “evolve” as a routine meets a challenge which forces the firm to adjust the way the routine would normally function. Thus, firms can evolve only as far as their capabilities allow. Since all firm routines are interconnected, once a routine changes, the organization changes. Thus the “evolutionary theory” of the firm is created: one that proposes that the collective efforts of firm members make it possible for the firm to change with its environment.

Dosi (1982) complements the work of Nelson and Winter by proposing the idea that the evolution of routines target the evolutionary requirements of innovations: the technological trajectories. These trajectories result from and reinforce the incremental improvements made towards innovations within a technological cycle. Dosi's argument fits nicely into the paradigm set forth by Nelson and Winter. However, whereas Nelson and Winter view the firm as constrained within a natural evolution of a current trajectory, Dosi allows for scientific breakthroughs that may propel the firm to a successive technological wave. Whether or how these breakthroughs may occur remain outside the scope of evolutionary theory.

In terms of firm timing, the evolutionary view of the firm generally posits that firms can only evolve with incremental technological evolutions (Dosi being the exception). Incremental improvements are achieved through the extension of current knowledge, a task that should be within the domain of incumbent firms. Therefore, a firm which times its entry into a technological cycle early may be able to add routines to evolve with a changing technological cycle as described by Abernathy and Utterback (1978): "crossing the chasm" as it were (Moore, 1991). Further, later entrants that have previously acquired the requisite skill sets needed as a later entrant, notably marketing and manufacturing skills (Lieberman & Montgomery, 1988; Robinson, Fornell & Sullivan, 1992), may compete with earlier entrants. However, should the skill sets needed to effectively compete at different points of a technological cycle differ substantially, the separate product and process innovation skills as described by Abernathy and Utterback (1978), we would expect to find those firms which possess product innovation skills to find new markets to enter which match their skill sets. Similarly, we would expect late timing entrants to find situations to deploy their process innovation skills-looking for more mature cycles to enter.

Evolutionary theory allows for new entrants, provided they succeed in developing the proper innovation which will be approved by the marketplace. This development may stem from prior experiences in other industries or through asset acquisition. Architectural innovations, on the other hand, would extend beyond the current skills and knowledge of the firm. Unless the firm is able to stretch its resources, it will be unable to adjust to the new knowledge links.

Although evolutionary theory acknowledges the existence of resources, the source and composition of these resources are foreign. Evolutionary economists lack a clear understanding of firm resources. For this definition of resources, we turn to the resource-based view of the firm.

2.3 Resource-Based View

The resource-based view (RBV) of the firm takes up where evolutionary theory ends by providing a finer grained analysis of how firm resources are either acquired or built. The impetus of the resource-based view of the firm, while some credit the works of Penrose (1958), is often credited to the works of Rumelt (1982), Wernerfelt (1984), and Barney (1986). According to the resource-based view, it is a firm's idiosyncratic resources (Rumelt, 1982), obtained by the acquisition of unique resources or the building of unique capabilities, that creates inter-firm heterogeneity, and thus is responsible for performance differences (Wernerfelt, 1984; Barney, 1991). Barney clarifies resources by pointing out that resources must be “valuable, rare, costly to imitate, and non-substitutable” (2001, p. 53). According to Barney (1991), a firm’s resources can be either one or more of financial, physical, human, and/or organizational. In terms of timing, the resource-based view of the firm may be able to help us better understand why firms can or cannot successfully enter technological cycles at certain points along the technological trajectory.

Research within the RBV discipline has generally evolved to uncover how valuable resources are created by the firm (Galunic & Rodan, 1998; Henderson & Cockburn, 1994). Galunic and Rodan (1998) report that a chief concern for the firm today is its ability “to innovate by searching out new resources, or new ways of using existing resources” (p. 1193). This argument is shared by Teece, Pisano, and Shuen (1997), who state that “private wealth creation in regimes of rapid technology change depends in large measure on honing internal technological, organizational, and managerial processes within the firm” (p. 509). Teece, et al. have identified several levels of firm capabilities including processes, the integration of activities within the firm; positions, the firm identified in terms of its assets; and paths, the alternatives of the firm.

Can an organization both select and deploy resources in a way that will lead to competitive advantage? If so, just how far can resource acquirement and utilization be stretched? It is in the study of firm processes, aptly described by Teece, et al. (1997), that one may find the bridge between resources and entry timing. Kogut and Zander (1992) write, “the capabilities of the firm in general are argued to rest in the organizing principles by which relationships among individuals, within and between groups, and among organizations are structured" (p. 384). Capabilities "are a high-level routine (or collection of routines) that, together with its implementing input flows, confers upon an organization's management a set of decision options for producing significant outputs of a particular type" (Winter, 2001, p. 983). Accordingly, a capability will be more substantial than a routine, knowable for the purpose of control, and in need of a coordinated information flow (Winter, 2001). It is these capabilities that allow for firm entry at different times of a technological life cycle.

However, the benefits afforded to the organization through the development of capabilities may have a hidden cost. Leonard-Barton (1992) warns of core rigidities stemming from core capabilities that can impede the innovativeness of firms, while Burgelman (1994) cautions of engrained processes causing inertial pressures. Just how flexible core competencies are and to what extent they can evolve over time is questionable, for the ability of a firm to change during discontinuous innovation is uncertain (Foster, 1986b; Rosenbloom, 2000; Tripsas & Gavetti, 2000; Tushman & Anderson, 1986). If true, the notion of core rigidities and inertia will keep firms situated in particular capabilities. As a result, since certain capabilities are more appropriately paired to certain points of the life cycle: product innovation being rewarded in the early stages of the cycle and process innovation being rewarded in later stages, we would expect firms to time their entry into cycles in a consistent manner. But, are there advantages to entering at any one particular point of the technological cycle?

One exciting area of research stemming from the combined efforts of the resource-based view and evolutionary theory is that which studies the timing into new technological cycles. It is thought that most new disruptive technologies are introduced to market through new entrants (Lieberman & Montgomery, 1988). According to Porter (1985b) and Lieberman and Montgomery (1998), great gains may be afforded to the early timing entrants into a new technological system. These advantages stem from three sources: technological leadership stemming from the learning that occurs through the early involvement with the new technology, the early mover's ability to preempt key assets in the growing of the new market, and the ability to co-opt buyers early and erect switching costs. Having to overcome the barriers built by early entrants can be a tremendously expensive proposition for entrants that arrive later.

With all the advantages available to early entrants, there exists the possibility of disadvantages as well (Porter, 1985b; Lieberman, 1998). The disadvantages may stem from the pioneering costs associated with working out imperfections in the new technology, developing a new set of distribution channels, and communicating the advantages of the new products to potential customers. In addition, because of the uncertainty that accompanies new products, management may make inappropriate choices in both system attributes and resource/capability building.

Teece (1986) argues that being first does not create a guarantee of garnering the returns from an innovation. Teece asserts, "innovating firms often fail to obtain significant economic returns from an innovation, while customers, imitators, and other industry participants benefit."(p. 231) Teece continues by pointing out that an important piece to the profitability puzzle for new innovating firms is the possession, by the firm, of certain complementary assets that will enable the innovator to thrive. Specifically, the successful implementation and development of a new innovation will depend on the strategic choices made by the innovator in regards to the pursuit and/or possession of these complementary assets. Teece's observation was validated by Tripsas (1997), who found that in the typesetter industry specialized complementary assets helped buffer incumbents against other first movers when new technological trajectories emerged.

Tripsas' research draws attention to the importance of differentiating between new entrants and industry incumbents. As such, Mitchell (1989, 1991) theorizes that "two clocks" are needed to understand and measure the full impact of timing decisions in the diagnostic imaging industry. Mitchell's first clock is to time the entry of new entrants, and his second clock is to time incumbent entry patterns. Mitchell finds that early newcomers generally gather market share, but are under a greater hazard than late newcomers, who have higher survival rates but never gain large market share. Of the incumbent entrants, the early entrants (still after the newcomers) garner positive performance results, while the late incumbents obtain negative performance results. Mitchell posits that incumbent entry is moderated by the collected idiosyncratic resources the incumbents possess (1989). Amburgey, Kelly, and Barnett's (1993) study of the Finnish newspaper industry found that firms experienced initial hazards during change behaviors, but that those hazards diminished over time. In addition, the authors found that firms that changed were more likely to engage in that change behavior again.

The resource-based view of the firm supplements the literatures of both technology and innovation management and evolutionary economists. By providing an in-depth examination of what firm resources are, the RBV allows this study to better explain the resources required for success at different times of an innovation life cycle. Combined with TIM, we can understand that firms competing in the early stage of a technology life cycle should possess unique factors that allow it to successfully create product innovation. For firms competing later in the innovation's trajectory, we would expect resources centered on process innovation to take precedence. Combined with evolutionary theory, the resource-based view of the firm more fully describes the changing nature of resources as firms evolve down a technological trajectory. If firm resources are static, unable to change, then we would expect that instead of evolving, successful firms would enter technological cycles at a stage that corresponds to their resource stockpiles. Therefore, firms with product innovation skills will continually seek technological cycles that will allow them to utilize their innovation skills, while firms with process skills would seek cycles where their marketing and manufacturing skills can be more readily leveraged.

While the resource-based view complements the evolutionary theorist, picking up on what factors make firms different, it suffers by not providing a prescription through which firms can determine which resources to stockpile in order to be successful. Further, the tacit nature of resources calls into question the ability of firm management to take stock of their current resource collections, measure this total against perceived needs due to technological changes, and take corrective actions to close the gap between possessed and needed resource stockpiles. In other words, how can the acquisition of one resource over another make a difference? In addition, the resource-based view of the firm, in and of itself, does not allow for the building of firm capabilities. The building of capabilities is best uncovered through the literature of the learning school.

2.4 Organizational Learning

The final cog in this study of firm entry timing is the fusion between the resource-based view and organizational learning. Whereas the resource-based view is adept at describing post-hoc how firms became successful, the learning school aids firms prescriptively by determining how to create and deploy resources for future successes. The learning school of thought suggests that firms are capable of change. The learning school views the firm as a collection of individuals, who, in turn, are repositories of knowledge. The management of knowledge is extremely important given the research that suggests 75% of firm market value is derived from its knowledge base (Havens & Knapp, 1999). It is this collective knowledge that is shared and focused towards the solving of problems.

The learning school can be traced back to Lindblom's (1959) "muddling through" and, to an extent, the works of Penrose (1958). Lindblom (Braybrooke & Lindblom, 1963) called attention to the irrational nature of firm decision making processes ("disjointed incrementalism"), pointing out that most decisions made by firms were made by members throughout the organization in attempts to solve problems that they were facing with little regard to superordinate goals. This view is not altogether at odds with the resource-based view of the firm as Penrose (1958) demonstrated that a firm's output consists of not only products, but of knowledge. According to Penrose, it is the growth of knowledge within the firm that allows management to earn future returns from its administered set of resources.

In 1980, Quinn presented a view of decision making somewhat different from Lindblom. While Quinn agreed with Lindbloom's incremental view of decision-making, Quinn felt that decisions made by firm members were targeted to overall firm improvements creating a type of "logical incrementalism." Quinn's views provide for more firm continuity, and thus limitations, than does Lindbloom in that Quinn suggests that a firm is tied to its past. This reflects much closer to the postulations of Nelson and Winter and the organizational economists.

To determine what "firm improvements" must be made, firms must adjust to their environment (Hrebiniak & Joyce, 1985). Weick (1979) ties the organization to its environment by positing that firms enact their environments. In enacting, Weick suggests that key players within a firm selectively filter information from outside the firm and enact decisions within the firm based on those perceptions. Burgelman (1983) points to top management as the key enactor of environmental conditions when he states that "top management's critical contribution consists of strategic recognition rather than planning" (p. 1349). These perspectives suggest a top down orientation of internal firm knowledge with the environment. These findings suggest that upper-level management guides the firm to its best resource utilization opportunity.

However, due to the bounded rationality of top management (Simon, 1997), multiple points of environmental filtration are sometimes needed by firms. These multiple points are evident in Burgelman and Grove's (1996) account of the strategic dissonance present between Intel's top management and its engineering managers. Upon recognition, top management can use the knowledge from its lower level managers to set more environmentally appropriate (one that reflects environmental reality) directions for the firm. Thus, the learning view provides us with a perspective on how firms can adjust to innovation changes.

The extent to which firms can adjust knowledge structures, or learn, is crucial to understanding firm timing over multiple technological cycles. While the learning school does provide for knowledge absorption ability, it does not go far enough in uncovering what these knowledges consist of and in what context. Therefore, without a more clear understanding of firm learning, we cannot come to an understanding of how learning and the technological cycle interact. Nor can we make clear assumptions as to the abilities of the firm to enter successive cycles at different time points. To come to this understanding, we must tie all of the theoretical underpinnings together.

2.5 A Fish Scale of Science

Barnett and Burgelman (1996) have called for a synthesizing of theory in order to gain greater insight into "dynamic, path dependent models that allow for possibly random variation and selection within and among organizations" (p.7). The blending of the frameworks presented to this point fits this perspective. The "Fish Scale of Research" figure presented in Figure 2.4 is a selected view of how the various disciplines have emerged and merged over the years to provide our knowledge of the timing of firm innovation efforts. Classification of the authors' work presented in Figure 2.4 is accomplished through analyzing the unit of analysis and object of study for the selected work, cross tabulated with the references and citations provide in each.

Of note is the predominance of works from the Technology and Innovation Management and the Resource-Based View of the Firm areas in recent years. The few examples from the Learning School and Evolutionary Theory are not meant to imply that those disciplines are dying off; rather, they each have contributed insights that have been absorbed by researchers in the TIM and RBV areas. For example, Cohen and Levinthall (1990) suggest that one way firms can survive multiple waves of technological cycles is by developing firm absorptive capacity: the ability of firms to learn and apply new capabilities. The conventional wisdom is that if a firm is able to generate dynamic capabilities, and those changing capabilities mirror the capabilities required by a succeeding technological environment, then the firm will be better positioned for survival as it can time its entry and flourish at any point along a technological cycle.

The focus on dynamic capabilities recognizes two major characteristics of innovation: 1) that there are different "types" of innovation requiring different skill sets than were required in preceding technological platforms, and 2) a recognition of the ever-changing nature of the firm's abilities to meet the pressures of innovation types. While studies to this point generally examined the impact on the firm and industry participants from one technological wave, with the recognition of dynamic capabilities it is evident that more work is needed in uncovering the impact of multiple waves of technology.

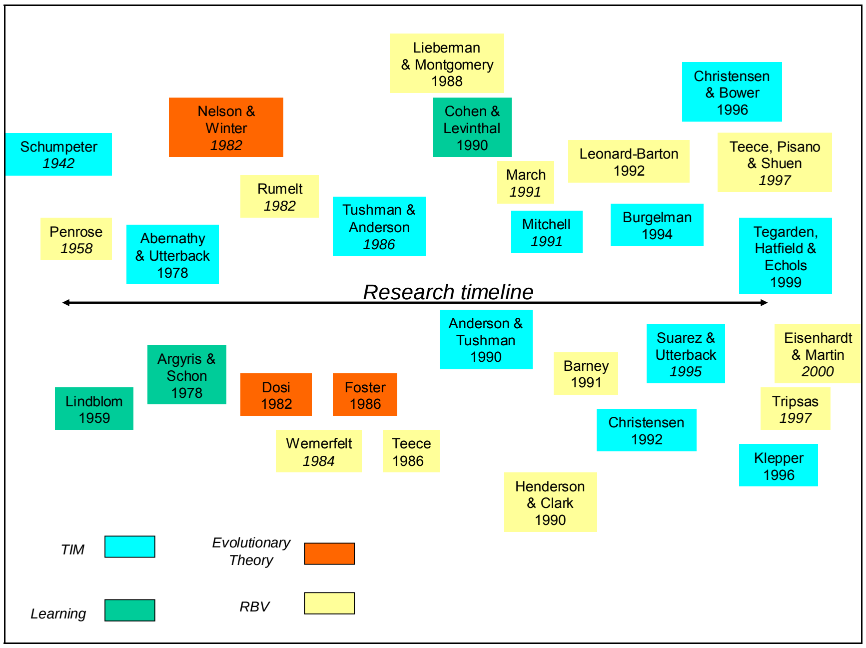


Figure 2.4. Fish Scale of Research Timeline

2.6 Different "Types" of Innovations

While different terms may be used to describe the attributes of technological changes, generally the classification schemes fall into one of two major groupings: either the technology reinforces the trajectory of the current technology; or the technology disrupts the incumbent technological trajectory (Dosi, 1982). Tushman and Anderson (1986) refer to these types as competency enhancing or competency destroying. Bower and Christensen (1995) refer to them as sustaining or disruptive, respectively.

Research has generally shown that successive innovations are more incremental in nature and may enhance the capabilities and success of industry incumbents (Abernathy & Utterback, 1978; Dosi, 1982; Klepper, 1996; Tushman & Anderson, 1986). On the other hand, more radical innovations may challenge incumbents' skills and abilities and instead allow new entrants to supplant incumbents in dominating an industry (Abernathy & Utterback, 1978; Amburgey, Kelly, & Barnett, 1993; Nelson & Winter, 1982; Romanelli & Tushman, 1994; Tushman & Anderson, 1986). Indeed, studies have shown that firms are more likely to fail when faced with changing environments (Henderson & Clark, 1990). As pointed out by Christensen and Bower (1996), it is difficult to "understand why strong, capably managed firms stumble when faced with particular types of technological change" (p. 215).

According to Henderson and Clark (1990), the determining factor as to whether or not a firm survives innovation waves is not simply a matter of the type of innovation that it faces (i.e., incremental versus radical). Instead, they point to whether or not the firm's architectural knowledge is enhanced or compromised as the determining factor as to whether or not a firm can adjust to new technological trajectories. To Henderson and Clark, knowledge of an innovation means that firms have both an understanding of the pieces of a technology (the components) and also how those pieces or components fit together (the architecture) (See Figure 2.5: Framework for Defining Innovation). According to the authors, firms can withstand changes to component concepts. However, any disruption in the architectural knowledge of the firm can disrupt the embedded processes and knowledge of the firm and can be extremely difficult to overcome. Henderson and Clark's story is one of firm inertia. If what Henderson and Clark theorize is true, then firms that time their entry early into a technological cycle should be able to effectively create incremental innovations within that technological cycle. However, architectural changes to its technology, resulting in a new trajectory, would be extremely difficult to manage. This perspective ties well with that of the technology and management literature, the evolutionary ecology literature, the resource-based view of the firm, and Quinn's view of logical incrementalism.

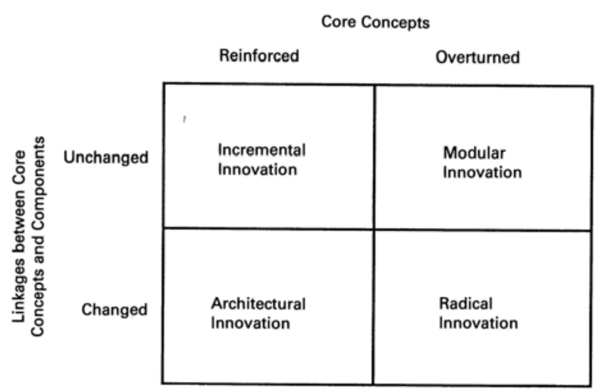


Figure 2.5 Framework for Defining Innovation (Henderson & Clark, 1990, p. 12). Reprinted from "Architectural Innovation - the Reconfiguration of Existing Product Technologies and the Failure of Established Firms" by R.M. Henderson & K. B. Clark. Published in *Administrative Science Quarterly, 35*(1), p. 12, by permission of *Administrative Science Quarterly.* ©

2.7 Changing Nature of Firm Capabilities

To this point, we have examined whether or not firms can evolve down a technological pathway, evolving from product to process innovation. However, firms may need to do much more. In their 1996 article, Tushman and O'Reilly point out that while most firms focus on either incremental or discontinuous change, to effectively adjust to changing environments, firms must be capable of meeting both types of innovation demands. This, in effect, requires the firm to be equally competent at meeting the needs of current customers, through incremental changes to products, while creating new innovations that may have discontinuous effects in the industry.

According to Schoonhoven and Jelinek (1990), to be successful in high-tech industries, firms must innovate high technology products that the market will embrace; employ innovative manufacturing processes; and adjust efficiently manufacturing abilities for these changes in product and process innovations. These pressures place a tremendous amount of tension on the organizational structures and prior strategic commitments of the organization and may be very difficult to accomplish. In addition, incumbent firms may not have the same economic incentives to explore innovations as their current customers may not initially want the successive innovation (Christensen & Bower, 1996). In fact, it has been empirically demonstrated by numerous authors that organizations have difficulty meeting the needs of more than one competitive priority (Abernathy & Utterback, 1978; Christensen, 1997; Foster, 1986a; Henderson & Clark, 1990; Tripsas & Gavetti, 2000; Tushman & Anderson, 1986).

With such a fatalistic view, one would think that firms might as well give up. However, there have been examples of firms that have succeeded in the face of disruptive technologies. Christensen and Bower (1996) point out that if firms have sufficient management and financial power, they may be able to not only survive, but prosper in times of disruption. Rosenbloom (2000) relays the story of NCR and its ability to evolve from a producer of mechanical cash registers to become a leader during the electronics and digital computing age. Teece (1986) asserts that GE was able to use its complementary assets to take advantage of the CAT scan. The use of specialized complementary assets unavailable to new entrants also allowed incumbent firms in the typesetting industry to survive disruptive change (Tripsas, 1997). Indeed, examples of successful navigations of radical technology are so common that Rothaermel (2001) suggests that they cannot be ignored.

Galunic and Eisenhardt (2001) offer advice as to how to structure a firm to allow for disruptive innovation. According to the authors, a firm must create a dynamic community. This community is one with a modular structure--independent but related (increases innovation while retaining recombinant opportunities); a competitive yet cooperative corporate culture; dynamic capabilities governed by rules applied with economic and social bases; and leaders that act as architects, entrepreneurs, and cultural guardians. A tall order indeed.

If the writings on dynamic capabilities are true, and firms have embraced and deployed these strategies, then we should see evidence of this in firm timing actions and outcomes. Specifically, we should see no discernable pattern to firm timing strategy. Therefore, firms that in one technological cycle enter early, should easily be able to enter late in future trajectories. Conversely, those firms that enter into a technological strategy late should have no problem with entering into subsequent cycles prior to the determination of the dominant design.

2.8 Timing

Abell proposes “the resource requirements for success in a business-whether these be financial requirements, marketing requirements, engineering requirements, or whatever-may change radically with market evolution” (1978, p. 24). This comparative advantage hypothesis indicates that the resources required to be a market leader differ from those needed to be successful at other entry points in a product's evolution (Robinson, Fornell, & Sullivan, 1992). Much of the literature suggesting the dynamic capabilities remains untested. Should a firm have the ability to retain and, more importantly, utilize dynamic capabilities, it would be able to adapt to more environmental situations and thus properly timing an entry would not be of great concern to firm management. No matter what time period those firms were to enter, they would be able to excel. We can, therefore, conclude that not only would dynamic capabilities provide value to the firm, they would give the possessor an advantage over other firms not in such possession.

Evidence of dynamic capabilities should show itself in the timing literature. There have been numerous timing studies (E.g. Lambkin, 1988; Lillian & Yoon, 1990; Mitchell, 1991; Robinson & Fornell, 1985; Urban, Carter, Gaskin, & Mucha, 1986. Kerin, Varadarajan, and Peterson (1992) provide an excellent overview of studies to that date), and generalizations have been suggested. Kalyanaram, Robinson, and Urban (1995, p. G214) suggest the following generalizations:

> "1) for mature consumer and industrial goods, market pioneers have sustainable market share advantages versus later entrants;
>
> 2) For consumer packaged goods and anti-ulcer drugs, the entrants market share divided by the first entrants market share roughly equals one divided by the square root of entry.

3) In mature consumer and industrial goods markets, market pioneer share advantages slowly decline over time.

4) More evidence is needed to determine if order of entry is related to long-term survival rates."

Clearly, there is still much to be learned from timing studies. For one, much of the previous literature is based on PIMS studies, which utilizes self-reported, mostly Fortune 500, entry strategy data (Kerin, Varadarajan, & Peterson, 1992). While self-reported data can be extremely useful, Buzzell and Gale (1987) report that 52% of the firms in the PIMS study classify themselves as pioneers, including multiple competitors in the same product category. This is problematic, considering that most definitions of "pioneering" firms in the traditional literature identify the pioneer as one, or one of the first, entrants into a new industry.

Much of the entry order timing literature creates a classification scheme that suggests a single market pioneer, either through superior skills and abilities or pure luck, introduces a product. From the advantages afforded to it by early entry (i.e., Lieberman and Montgomery's first mover advantages), they are able to gain superior market share over later entrants. Another possibility exists, where instead of a focus on a market pioneer; we instead examine the market leaders. The use of the term "leader" reflects the growing interconnected nature of firms, suppliers, and customers, and the nesting of technologies. As posited by the TIM literature, each cycle is first consumed with repeated trials and errors. The establishment of a common design is made from the collective inputs of several of these trials and errors. In many technology fields, there is not truly one "pioneering" firm-- instead, there are multiple firms that compete with each other to contribute components of a product offering. Unfortunately, many of the previous studies do not examine timing in a highly dynamic industry, and thus its applicability to certain fields is limited. This is disappointing in that technology fields can often be grouped by those firms that employ research and development to gain an advantage versus those that rely on assimilation of product made by other firms.

3.0 HYPOTHESES

3.1 Does engaging in certain initial timing strategies make firms more likely to follow similar timing strategies in the future?

Christensen proposed that firms follow defacto innovation strategies, in that their actions and skills are generally oriented towards timing their entry into new cycles either early or later along a technological trajectory (1992a). Those firms that time their entry early are generally considered to follow a leadership strategy, while those that enter later are considered to follow a follower strategy (Porter, 1985a). Evolutionary economics asserts that firms are predisposed to view and to respond to new technological cycles in a manner connected to the heuristics established in prior cycles (Dosi, Nelson, & Winter, 2000). Firm entry timing into new cycles, therefore, will be based by firm management on the successes achieved in previous cycles' timing position.

Firms seek to acquire and deploy resources in a way that matches their entry timing. For timing entry to have the best possibility of success, those firms with research and development skills should enter earlier into a technological cycle, and those firms with manufacturing and marketing skills to enter later (Porter, 1980). For the timing leader, innovations are oriented towards advancing the young technology and establishing an overarching system of component technologies for which the firm hopes to be chosen as an industry standard (Afuah, 1998). During this early period of a product life cycle, firms typically utilize inefficient general purpose equipment to produce functional products that frequently change to reflect the fluid desires of the early users of the innovation. For the technological leader to compete successfully in the early stage of the lifecycle, processes must be established, positions must be taken, and pathways must be defined and laid out so that a competitive offering can be developed (Teece, Pisano, and Sheun, 1997). Heuristically bounded, management investments into these leadership timing skills sets will be enhanced and nurtured over time, creating strong organizational capabilities.

As market demand for a product expands, firms must create ways to meet that demand-both in terms of quantity and quality. In crossing the chasm, firms must meet these demands through the generation of process innovations (Moore, 1991). The skill sets that make the technological leader adept at meeting the demands of the early stages of a trajectory, having been carefully built and nurtured by firm management, are not the same skills required to meet these new process innovation demands. Changing capabilities is difficult as the firm’s capabilities become rigid and nonmalleable over years of entrenchment and buildup (Leonard-Barton, 1992). Continuing to offer product innovation improvements is only marginally appropriate, as the level of performance improvement for any innovation declines over time as there just are not that many more improvements that can be squeezed out of the technological system in its present form: the technology approaches its “technical potential” (Foster, 1986b).

The technological leader is left with a choice: continue to pursue returns from an environment for which it is ill-equipped, or leverage its product innovation skill sets into new ventures. The evolutionary economist would suggest that the firm will seek out new early timing opportunities in which to enter, as it allows for the incremental advancement by the firm. Another positive result from the entry timing leader repeating its leadership standing is the message it sends to investors, customers, and suppliers. Through continued success in early entry, the message to these stakeholders is that the leader firm is a technological leader and worthy of confidence regarding its future. The result is more investment in terms of capital, alliances, and purchasing. These actions work to reinforce the early timing decisions made by management. In sum, leaders are best at being leaders and will seek out opportunities in which it can do so.

Later in the cycle, a firm's ability to manufacture and achieve economies of scale is crucial to achieve success. Specifically, it has been suggested that manufacturing skills encourage early following, and that marketing skills encourage late entry (Lambkin, 1988; Lambkin & Day, 1989; Lilien & Yoon, 1990). Firms that choose to enter into later periods of a cycle, as opposed to those that time their entrance earlier in the cycle, are those firms with the skill sets that allow it to replicate and mass produce the offerings chosen by lead users. There is much pressure during this stage to reduce costs and increase quality. Further, there is a large emphasis on developing tight structure and operational rules and procedures (Abernathy & Utterback, 1978). Late timing entrants, these followers must be able to leverage manufacturing ability in the pursuit of economies, blended with the marketing expertise necessary to fully divest of its manufacturing buildup.

Just as the technological leader's abilities were tied to previous actions, so too are the technological followers. Technological follower processes, pathways, and positions are oriented towards the large scale production and distribution of established technological products (Teece, Pisano, & Shuen, 1997; Tushman & Murmann, 1998). Hence, as the organizational economist suggest, the firm will be only able to evolve incrementally from previous abilities. Engaging in future follower activities would make the most of the resources and capabilities the follower firm possesses. As was the case with the consistent leaders, consistent followers will also provide external constituencies a congruent view of the firm, spurring higher investment and involvement. These factors lead to long-term success. Following this logic, the first set of hypotheses to be tested are:

H1a: Leaders are more likely to be leaders again when facing successive incremental innovation cycle changes.

H1b: Followers are more likely to be followers again when facing successive incremental innovation cycle changes.

There is, however, a danger to consistent firm activities over extended periods. Reinforcing prior capabilities creates inertial patterns and possible core rigidities (Leonard-Barton, 1992). The calcification of capabilities may serve the firm well in times of incremental change. However, if a successive wave alters the basic connections and linkages of a product's architecture, firms may make it difficult to impossible for a firm to adjust (cu., Christensen, 1992; Henderson & Clark, 1990). According to Henderson and Clark (1990), firms can withstand changes to component concepts, while changes in the linkages between these core concepts and components are more difficult to withstand as firms are encumbered by engrained concepts related to the way component technologies interact.

Innovation leaders faced with an architectural change must make a decision: should they enter into the radical trajectory early or wait and play catch-up? Early timing into a new technological cycle may be impossible to achieve for the pioneering firm because of inadequate or engrained capabilities in terms of systems, process, or skills associated with the incumbent technology (Leonard-Barton, 1992; Teece, et al., 1997). In addition, early entry timing may require the acquisition of physical or knowledge-based specialized assets which may seem too risky of an investment in the uncertain environment of a new technological cycle requiring an architectural change (Arthur, 1987; Williamson, 1985). For these reasons, it will be difficult for an innovation leader in previous cycles to continue to be an innovation leaders when faced with an architectural change. To be tested, then, is the following hypothesis:

H1c: Leaders are less likely to be leaders again when facing architectural innovation cycle changes.

The innovation follower facing architectural changes may not face the same perils. As previously suggested, successful innovation followers develop skill sets that maximize manufacturing and marketing ability. As such, these late entry timers are less concerned with the engineering and functioning of a technology than they are with the ability to reproduce and mass market the creations of others. These skill sets can be much more applicable to varied product characteristics. Whereas a leadership firm may experience much discomfort to the altering or dissolution of skill sets based on prior architectures, followers and their skilled adaptation may meet those changes head on. With the suggested ease of change by followers, our next hypothesis to be tested is:

> H1d: Followers are more likely to be followers again when facing architectural innovation cycle changes.

3.2 Do consistent firm timing strategies affect firm market share?

Robinson, Kalyanaram, and Urban (1994) found that innovators generally maintain market share leads over later entrants. This evidence appears to support some research claims that the advantages associated with early entry outweigh potential drawbacks (Lieberman & Montgomery, 1998). If this is indeed the case, how do firms that time their entry as followers maintain investors and performance? The key may be in the firm's ability to consistently time its entry, thus gaining momentum and stronger capabilities.

For timing leaders to achieve sustained market share in a given technological trajectory, they would have to either erect barriers to keep early consumer adopters from switching to later entrants, or evolve its skill sets to compete on equal footing with those later entering firms--the possessors of manufacturing and marketing skills. Evolutionary economics would advise that switching skills sets may be impossible for the timing leader to gain a superior advantage over other firms, and recommend to the leader to switch to new leader opportunities that will allow for the leveraging of research and development skill sets.

Should the leader attempt to focus its efforts on later stages, it will find itself fighting not only external, but also internal, battles. Political infighting and pressures may create frictions within the firm which can reduce its ability to meet customer needs. Further, external constituents (e.g., customers and suppliers) may be confused with the change in strategy. Inconsistent switching behavior can also cause the firm to alienate established relations with industry participants, employees, and customers. Especially in high technology settings, there can be much interfirm cooperation in the development of new product offerings. Through inconsistent switching, and skill set acquisition, an inconsistent firm will be viewed as a laggard, and thus superfluous to development ideas. Further, inconsistent entries can cause confusion to customers that are uncertain as to the future actions firms will take. For goods that represent high customer customization and involvement, the need to continue in dealings with the inconsistent timing firm will be called into question. In addition, capital markets may not possess the same level of confidence in unproven strategies, and thus firms risk losing investment dollars.

Leaders that consistently time their entry as leaders will experience a strengthening of its competencies in research and development. Also, leaders staying consistent as leaders allow the firm to seek out new technological trajectories. Consistent results in finding new markets will be viewed by capital markets as a sign of differentiation and strength, yielding future investments into the leadership firm, and thus long-term survivability. These assertions lead to the following hypothesis to be tested:

H2a: Leaders that consistently time their entry as leaders will realize higher market share than those leaders that switch to follower patterns during incremental technological changes.

Followers experience many of the same timing switching perils as the leaders. Consistent timing efforts oriented towards followership is focused on entering technological cycles after the base technological architecture of innovations are settled upon. The follower then utilizes efficient manufacturing expertise in the pursuit of economies of scale and marketing expertise oriented towards the creation of market space to capture market share. Manufacturing and marketing capabilities, like research and development expertise, must be built over time through continued re-investments. While followers may make incremental innovation changes to leader offerings, their ability to create and ride down new technological trajectories is limited. Specifically, the systems and processes required to identify and respond to leader offerings may not be capable of carrying an innovative offering from the idea stage to market. Any investments made into leadership capabilities would come from resources that could be better used in furthering scale capabilities or deepening marketing expertise. Building upon existing skill sets will allow the follower to capture market share from leaders in current and future technological trajectories. Therefore, we would expect that, over time, followers would serve shareholder interests best by focusing efforts on follower behaviors. It is suggested that:

> H2b: Followers that consistently time their entry as followers will realize higher market share than those followers that switch to leader patterns during incremental technological changes.

While early entry timing consistency is a positive attribute during incremental cycle changes for technological leaders, architectural changes present much larger hurdles. For the consistent timing leaders with a history in industry development, architectural changes represent fundamental rethinking as to how the basic technological structure of the product is formed. Further, attributes that may have once been vital to the performance of a product may become superfluous with the new product architect. While new entrant timing leaders have their offering applauded by lead users, the inability of incumbent leaders to understand the intent of the new structure will lead the consistent innovation leader to make poor investment decisions regarding product attributes in relation to customer desires. So, while the timing leader may enter the new cycle, its offering may be viewed as pedestrian or inferior to competing architectural structures. As a result, the performance of the consistent leader will suffer. In terms of market share, the following hypothesis shall be tested:

> H2c: Leaders that consistently time their entry as leaders will realize lower market share than those leaders that switch to follower patterns when faced with architectural technological changes.

While the leader struggles to apply meaning to the basic product architecture, the consistent follower, with its investment in adaptive capabilities, will have a much easier time making adjustments to architectural changes. The follower excels in waiting for architectures to be established, and then using its manufacturing and marketing abilities to quickly gain market share. These capacities may more easily adjust to changes in product architecture. As a result, no demise in performance for timing followers is predicted during architectural changes. Thus, the next hypothesis to be tested is stated as follows:

H2d: Followers that consistently time their entry as followers will realize higher market share than those followers that switch to leader patterns when faced with architectural technological changes.

3.3 Do consistent firm timing strategies affect firm hazard rates?

Timing consistencies are posited to lead to greater market share for both leaders and followers during incremental cycle changes, and that architectural changes negatively impact leader market share but not followers. While market share does not necessarily reflect profitability, falling market share, ceteris paribus, is an indication to markets that a firm's future viability may by in peril. Further, a firm may maintain market share only by making huge investments that cannot be sustained. Therefore, in addition to testing consistency impacts on market share, it is crucial to determine the hazard, and thus survival probabilities, associated with timing consistency efforts over multiple cycles.

Consistent with our earlier hypotheses, we would expect to find that during incremental technological changes, consistent timing strategies will lead to a reduction of firm hazard. The cost of maintaining customers during these periods and making the necessary adjustments should not be unduly hard on a firm. Further, investors will view a firm making evolutionary steps as retaining its viability, and thus a sound investment opportunity. Continued capital investments will lead to increased abilities to maintain firm capabilities: for both timing leaders and timing followers. Therefore we make the following predictions:

H3a: Leaders that consistently time their entry as leaders will realize lower hazard rates than those leaders that switch to follower patterns during incremental technological changes.

H3b: Followers that consistently time their entry as followers will realize lower hazard rates than those followers that switch to leader patterns during incremental technological changes.

As with market share, we would expect architectural changes to be more hazardous to the consistent timing leaders than to the timing followers. Specifically, timing leaders will either be unable to see the opportunities presented to them in architectural changes, or be unable to understand the underlying relationships among the component of the new innovation. Either outcome may lead to poor firm performance, which will be penalized by investors disappointed by poor relative performance, by customers unhappy with product offerings, and employees discouraged by a lack of firm growth opportunities.

Followers, on the other hand, should be much better positioned to maintain performance. In turn, the maintaining of performance should lead to continued market support. To test these assumptions, we predict:

H3c: Leaders that consistently time their entry as leaders will realize higher hazard rates than those leaders that switch to follower patterns when faced with architectural changes.

H3d: Followers that consistently time their entry as followers will realize lower hazard rates than those followers that switch to leader patterns when faced with architectural changes.

4.0 METHODOLOGY

4.1 Research Setting

Research indicates that today's business environment can be extremely turbulent (Eisenhardt, 1989; Eisenhardt & Tabrizi, 1995; Galunic & Eisenhardt, 1996; Gersick, 1991). Relatively stable periods have been found to be shorter and shorter as the environmental conditions faced by firms change rapidly (Eisenhardt, 1989). In these "high velocity" environments (Eisenhardt, 1989), change is often not linear as "market boundaries are blurred, successful business models are unclear, and market players are ambiguous and shifting" (Eisenhardt & Martin, 2000). Given the growing prominence of these turbulent environments in the current business environment, this study will test the stated hypotheses within an environment which epitomizes these dramatic shifts: the PC industry (Lawless & Anderson, 1996). Of particular importance in this study are individual firm actions of those participating in the PC industry between the years 1975 to 1991. It is the actions of these firms that will serve as the unit of analysis in this study.

The PC industry, since its inception in 1975, closely traces the definition of a high velocity environment as described by Eisenhardt (1989) (See Appendix A for a brief overview of the more dramatic events in the PC industry). The industry has experienced two discontinuities and a myriad of competitors at all levels of the value chain utilizing multiple business models (Lawless & Anderson, 1996). According to Anderson (1995, p. 50), the factors that lead to the success or failure of firms appears not to be a simple matter of producing "superior technology," but rather the ability of firms to create legitimatization, standardization, and compatibility. The PC industry epitomizes organization evolutionary thinking in that changes within the industry appear to have occurred through a process of firm experimentation and failure, leading to the introduction of new experimentation (Anderson, 1995). As such, the industry can be seen to have evolved through “successions of technology cycles” (Anderson & Tushman, 1991, p. 26) creating destruction to previous technological cycles (Schumpeter, 1942). For these reasons, the PC industry makes for a justifiable case study to test the hypotheses presented.

The testing data used details all entries of firms into the PC industry between the years 1974 to 1992. For testing purposes, this date range will be reduced to the years 1975 to 1991. The time frame reduction marks the first year in which PCs were shipped at the lower end and an allowance for outcomes of market responses to actions to be fully realized at the upper end of the range (Tegarden, Echols, & Hatfield, 2000). The data used for the testing of the hypotheses comes from a variety of sources, including the Processor Installation Census (PIC database) from International Data Corporation (IDC). This database contains detailed firm information for most firms that entered the PC industry between the years 1974 and 1992. The database includes firm names, product introduction dates, and choice of microprocessor, along with information regarding annual shipments and average price of the model offered by year. The IDC database was further supplemented with microprocessor, model, and firm data by researchers at the University of Colorado and Cornell University (Tegarden, 1992).

The dataset has been widely used and validated by researchers adding credibility to the results obtained from the testing of our hypotheses (Henderson, 1999; Lawless & Anderson, 1996; Tegarden, Hatfield, & Echols, 1999). While the continuation of the dataset to the present time would be ideal, the dataset used here does represent multiple incremental cycle innovations, as well as an architectural innovation and should, therefore, adequately test the hypotheses in question. Researchers have demonstrated that there is much to be learned from studying past data sets [for example, Tripsas's typewriter study (1997), Tushman and Anderson's study of multiple industries over time (1986), Barnett's studies in telecommunications (1990), or Chandler's study of General Motors, Sears, Standard Oil of New Jersey, and DuPont (1962)]. According to Robins, "in the absence of specific grounds for suspecting spuriousness, there is no reason to question the age of the data" (2004, p. 269).

This research effort is considered to be correlational research, as we cannot manipulate the data, rather we can only measure latent outcomes. As a result, we cannot conclusively investigate any causality between our variables. However, the theory we build upon can aid in interpretations of relationships (Pedhazur & Schmelkin, 1991). Censoring of data occurs when the outcome of the dependent variable of interest (in this case firm termination) is not observed due to its occurrence either before (Type 1 censoring) or after (Type 2 censoring) the range of data used (StatSoft, 2003). Data for the testing of the hypotheses are right censored, and in particular, display Type 1 censoring, in that we are only aware of the firm's failure up to the end of the data range, 1992.

A population of 585 U.S. firms are included in the dataset, producing a total of 3,521 different models. Of these total counts, 560 firms competed by producing desktop models, and 125 firms produced laptops, with 25 of these firms not competing in the desktop sector. Anderson (1995) states that the PC industry seems to be governed by an imaginary clock, counting down the time of open entry for potential participants (p. 53). From this statement, we can infer a window of opportunity in which firms can successfully time their entry into a cycle and realize rewards. Such windows have been found in prior studies of entry and performance (Christensen, Suarez, & Utterback, 1998). While Christensen, Suarez, and Utterback's study was of a PC component (rigid disk drives), it is reasonable to assume that such a window may also exist in the PC industry. A firm entry is identified in the month when a firm first ships a PC model. An exit is identified when a firm no longer ships any of its models. Tables 4.1 and 4.2 provide details as to the number of entries and exits in the PC industry between the years of 1974 and 1992. Figures 4.1 through 4.5 provide graphics details of PC entries and exits by cycle type. Tables 4.3 and 4.4 present total unit sales and total dollar sales, respectively, for the PC industry.

Prior studies have indicated that the microprocessor is the heart of the computer (Anderson, 1995) and is, therefore, the best component to use as an indication of firm product choice (Tegarden, Hatfield, & Echols, 1999). As all other product architecture is built around the specific processor used for a PC, the microprocessor sets the limits and capabilities of the firm implementing it, and therefore defines the firm's product architecture (Anderson, 1995; Baldwin & Clark, 1997; Tegarden, Hatfield, & Echols, 1999). A microprocessor “is an electronic computer central processing unit (CPU) made from miniaturized transistors and other circuit elements on a single semiconductor integrated circuit” (Laborlawtalk.com, 2005, p. 1). CPUs can be defined by the speed at which the processor register can execute computer programs. This number is often cited by the microprocessor word length and the number of bits it can carry at a time (data bus length). Each processor type that evolved to become the dominant design has been identified to be an incremental innovation for the industry. Included in this time period are five incremental cycle changes (See Figure 4.6: PC Incremental and Architectural Changes). 203 firms were able to only offer models in one technological cycle. These single entry firms stayed in the PC market for an average of 3.27 years, with a standard deviation of 2.25. This study is particularly interested in firm timing entry changes from one cycle to another; therefore, firms that competed in only one cycle were not included in this analysis. All together, the data used to test our hypotheses is based on 359 firms completing in 755 model changes, with an average of 3.85 years spent competing in each cycle (s.d. = 2.22).

Table 4.1
PC Firm Entries by Year

	8/8 Cycle	16/8 Cycle	16/6 Cycle	32/6 Cycle	32/2 Cycle	Laptops
# Firms Producing Each Model Type	122	212	360	208	324	125
First Shipped in 1974	0	0	0	0	0	0
First Shipped in 1975	5	0	0	0	0	0
First Shipped in 1976	0	1	0	0	0	0
First Shipped in 1977	10	6	1	0	0	0
First Shipped in 1978	7	0	3	0	0	0
First Shipped in 1979	20	2	2	0	0	0
First Shipped in 1980	10	5	3	0	0	0
First Shipped in 1981	29	4	4	0	0	0
First Shipped in 1982	20	6	11	0	1	1
First Shipped in 1983	13	17	18	0	2	0
First Shipped in 1984	4	47	36	1	2	0
First Shipped in 1985	1	42	62	1	4	4
First Shipped in 1986	1	35	66	1	15	3
First Shipped in 1987	1	30	66	7	91	33
First Shipped in 1988	0	9	43	18	87	20
First Shipped in 1989	0	6	25	70	50	30
First Shipped in 1990	1	1	13	66	42	51
First Shipped in 1991	0	0	7	41	27	47

Table 4.2
PC Firm Exits by Year

	8/8 Cycle	16/8 Cycle	16/6 Cycle	32/6 Cycle	32/2 Cycle	Laptops
Last Shipped in 1974	0	0	0	0	0	0
Last Shipped in 1975	0	0	0	0	0	0
Last Shipped in 1976	0	0	0	0	0	0
Last Shipped in 1977	0	0	0	0	0	0
Last Shipped in 1978	1	1	0	0	0	0
Last Shipped in 1979	3	2	1	0	0	0
Last Shipped in 1980	4	1	0	0	0	0
Last Shipped in 1981	10	3	0	0	0	0
Last Shipped in 1982	18	1	1	0	0	0
Last Shipped in 1983	10	2	0	0	0	0
Last Shipped in 1984	15	3	3	0	0	0
Last Shipped in 1985	17	17	17	1	1	1
Last Shipped in 1986	17	16	15	0	2	0
Last Shipped in 1987	13	33	34	0	14	5
Last Shipped in 1988	7	31	38	1	22	9
Last Shipped in 1989	1	28	35	4	18	11
Last Shipped in 1990	1	41	54	18	39	18
Last Shipped in 1991	5	31	161	177	222	142

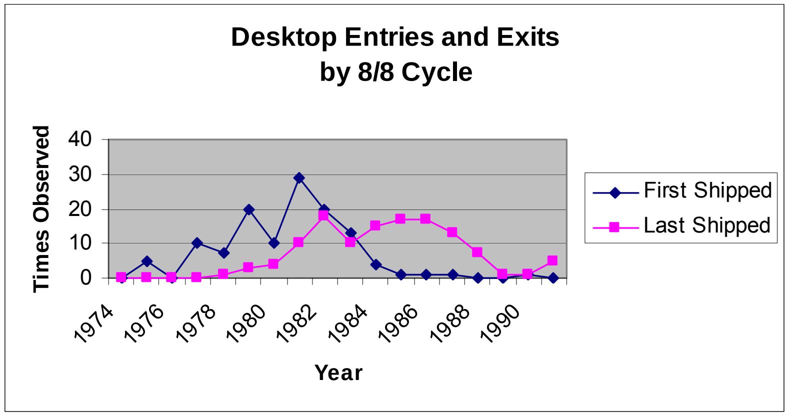


Figure 4.1: 8/8 Cycle Desktop Entries and Exits

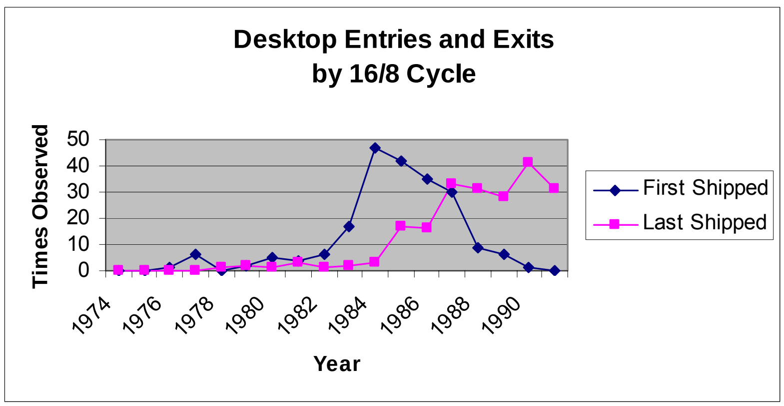


Figure 4.2: 16/8 Cycle Desktop Entries and Exits

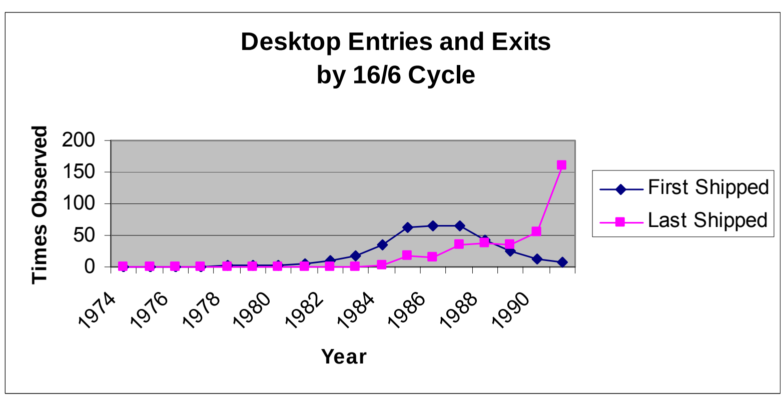


Figure 4.3: 16/6 Cycle Desktop Entries and Exits

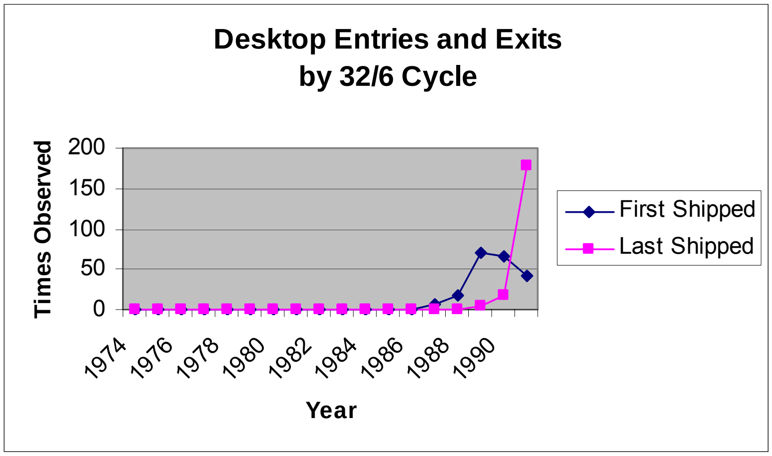


Figure 4.4: 32/6 Cycle Desktop Entries and Exits

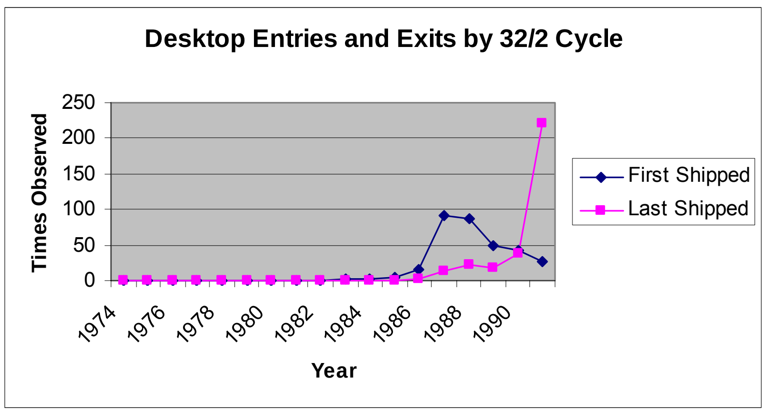


Figure 4.5: 32/2 Cycle Desktop Entries and Exits

Table 4.3
PC Units Shipped by Year

	8/8 Cycle	16/8 Cycle	16/6 Cycle	32/6 Cycle	32/2 Cycle	Laptops
Units Shipped in 1975	4,870	0	0	0	0	0
Units Shipped in 1976	6,251	100	0	0	0	0
Units Shipped in 1977	29,884	2,300	50	0	0	0
Units Shipped in 1978	148,410	7,005	650	0	0	0
Units Shipped in 1979	211,931	4,240	4,090	0	0	0
Units Shipped in 1980	418,329	19,297	16,552	0	0	0
Units Shipped in 1981	675,428	69,423	13,905	0	0	0
Units Shipped in 1982	2,251,320	243,756	532,058	0	0	38
Units Shipped in 1983	3,732,332	838,481	852,962	0	155	2,962
Units Shipped in 1984	3,865,118	2,164,972	588,557	30	1,410	14,000
Units Shipped in 1985	2,204,532	2,349,791	1,015,358	2,050	21,280	58,330
Units Shipped in 1986	2,149,133	2,551,199	1,922,697	4,050	66,400	45,750
Units Shipped in 1987	1,411,252	2,120,544	3,989,397	12,700	336,803	208,786
Units Shipped in 1988	834,710	1,491,731	4,592,168	89,270	872,051	615,599
Units Shipped in 1989	542,900	992,584	4,285,312	527,205	1,456,175	937,859
Units Shipped in 1990	282,500	550,977	3,426,406	1,877,570	2,108,473	914,749
Units Shipped in 1991	99,520	91,165	1,959,565	3,219,621	3,011,946	1,058,252

Table 4.4
PC Dollar Sales (in 000's) by Year

	8/8 Cycle	16/8 Cycle	16/6 Cycle	32/6 Cycle	32/2 Cycle	Laptops
Unit Sales in 1975	58,850	0	0	0	0	0
Unit Sales in 1976	81,093	1,200	0	0	0	0
Unit Sales in 1977	112,126	18,520	175	0	0	0
Unit Sales in 1978	343,569	61,755	5,225	0	0	0
Unit Sales in 1979	519,992	34,795	19,410	0	0	0
Unit Sales in 1980	949,412	70,816	59,558	0	0	0
Unit Sales in 1981	1,456,020	276,582	106,660	0	0	0
Unit Sales in 1982	2,661,974	1,020,389	669,072	0	0	304
Unit Sales in 1983	4,049,623	3,078,952	988,217	0	2,585	23,696
Unit Sales in 1984	3,593,734	6,542,877	2,225,590	694	23,589	84,000
Unit Sales in 1985	1,977,796	5,637,151	3,802,597	5,400	74,266	284,435
Unit Sales in 1986	1,506,355	5,677,735	6,123,796	8,525	287,676	165,080
Unit Sales in 1987	939,207	3,184,644	10,774,553	30,942	1,649,590	699,544
Unit Sales in 1988	621,537	1,770,196	10,651,363	290,096	4,195,679	1,555,773
Unit Sales in 1989	488,981	1,041,582	8,173,558	1,623,839	6,378,492	2,314,727
Unit Sales in 1990	272,923	524,491	5,827,458	5,019,543	8,461,420	2,416,255
Unit Sales in 1991	88,470	78,744	2,591,615	6,815,870	9,413,820	3,018,747

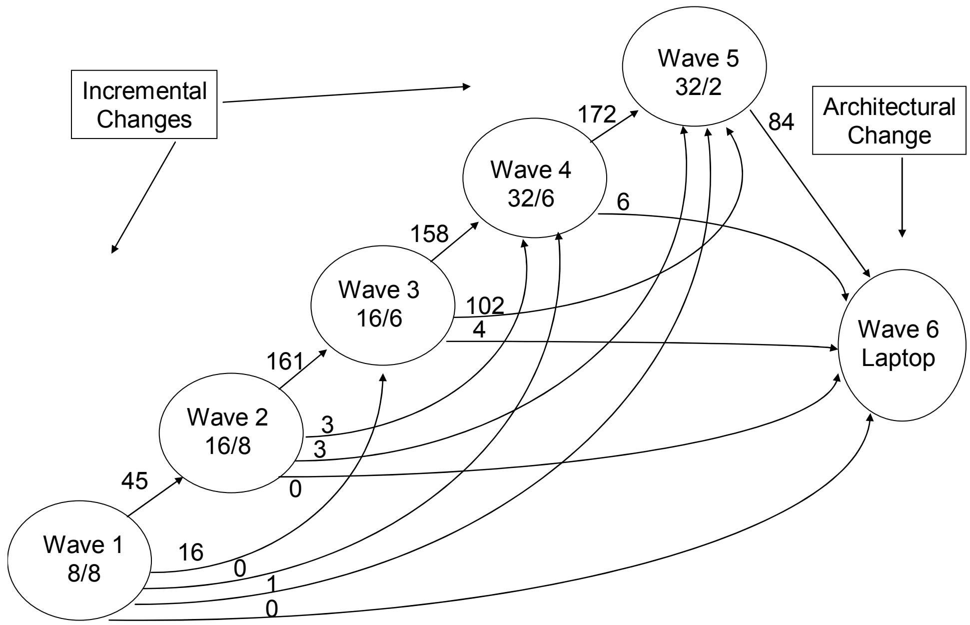


Figure 4.6: PC Incremental and Architectural Changes Count

From its inception in 1974 to 1991, the PC industry has experienced two architectural changes. The first occurred during the inception of the industry, as participants entered the newly formed industry. The second occurred with the introduction of the laptop computer. Henderson and Clark indicate that an architectural innovation is one which "changes the way in which the components of a product are linked together, while leaving the core design concepts untouched" (Henderson & Clark, 1990, p. 10). The example used in their 1990 article is of a large, mounted fan manufacturer unable to adjust to the creation of portable fans. The authors state that even though the components are the same (that is, both products have blades, motor, etc.), the architecture of the two products is very different. For the PC industry, even though the same processors from the PCs are used in the laptops, the architectural design of the laptop is different. Therefore, the laptop computer market makes for an excellent example of an architectural product introduction. Laptop data regarding entries and exits, number of participants, units shipped for each cycle type, and total dollar sales are presented in Tables 4.3 and 4.4 and Figure 4.7.

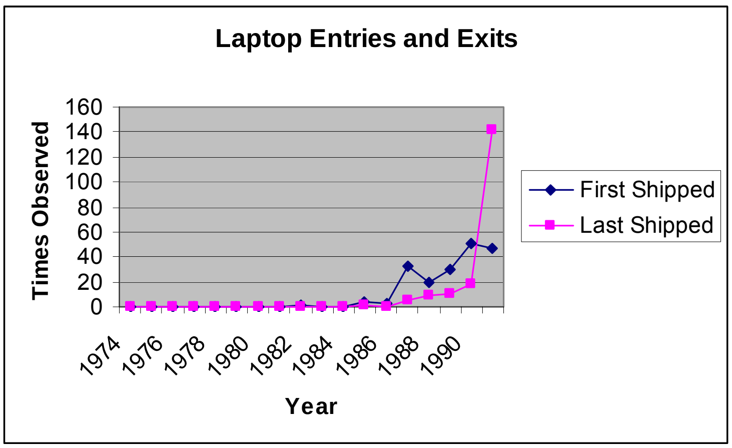


Figure 4.7: Laptop Entries and Exits

4.2 Variables

The following identifies and describes the variables used for testing in this study. Previous operationalization of variables in timing research can be found in Appendix B.

4.21 Independent Variables

Timing Strategy (Leader or Follower): Lieberman and Montgomery state that the "standard definition (of leading firms) is based on market entry" (1988, p. 51). The authors continue by stating that entrants can be classified as to:

1) *their numerical order in the sequence of entry;*

2) *elapsed time since entry of the pioneer;*

3) *general categories such as early follower, late follower, differentiated follower, 'me too' follower, etc.;"* (p. 51)

The classifications of leaders and followers can be seen as two points of a continuum (Kerin, Varadarajan, and Peterson, 1992; Miller, 1988). Leaders can be viewed as innovators in the industry in the creation of technologies. Leadership attempts have been identified as a technique to capture valued market segments, achieve economies of scale, set industry standards, and control distribution channels (Golder & Tellis, 1993). Followers generally are thought to copy the technological creations of the leaders, adding value through their manufacturing or marketing prowess. This value may mean the offering of a wider assortment of products or by charging lower prices (Porter, 1985a). To establish the effect of disparate operationalizations, this study will examine entry across multiple levels of demarcation.

At one extreme, entry timing will be dichotomized as either a "leadership" entry or a "followership" entry. Multiple techniques of categorizing entry timing have been utilized in past timing studies. Abernathy and Utterback (1978) and Dosi (1982) cited two main timing stages: the preparadigmatic and the paradigmatic stages. Firms fighting to win acceptance for their technologies define the preparadigmatic stage. The focus during this period is on process and product development. Once a dominant design has been established, the industry moves to a paradigmatic stage. This stage is characterized by price competition as economies of scale and economies of learning become crucial.

In another traditional method of categorizing entry, the very first entrant is determined to be the "pioneer" (Robinson, Fornell, & Sullivan, 1992; Schmalensee, 1982; Urban, et al, 1986). Any timing ties at this point are also generally included as pioneers. "Early followers" enter the market after the pioneers: while the market is still growing. Finally, late followers enter after the market is more established. This three stage breakdown coordinates with Utterback and Abernathy's (1975) uncoordinated, segmental, and systemic stages.

Gort and Klepper (1982) created five distinct category zones. "Stage 1" includes the first few entrants into a cycle. "Stage 2" is characterized by a sharp increase in the rate of entry into the technological cycle. "Stage 3" exists when a balance is achieved between the new entrants and exiting firms. "Stage 4" sees negative entry, while "Stage 5" experiences no new net entry.

These previous studies form the basis for the operationalizing of the "leader/follower" dichotomization used in this study. While several studies utilized PIMS studies to identify pioneers and ended up with 52% of respondents identifying themselves as "pioneers" (Kerin, et al, 1992), this study will be more restrictive in its identification of leaders. Gort and Klepper's (1982) first two stages of entry correspond well to the preparadigmatic stage of Abernathy and Utterback (1978) and the pioneer and early follower stages as described by Robinson, Fornell, and Sullivan (1992). In all three accounts, firms are described as competing in an era of relative uncertainty regarding acceptance of product architecture. The point of inflection that separates increasing rates of entry and decreasing rates of entry would be the ideal point of separation between firms timing their entry as leaders and those that are timing their entry later as followers.

Entry timing as a dichotomous measure is classified by first calculating the number of months from January of 1974 that the firm entered the market. For this study, the demarcation point for the leader and the follower is defined as one standard deviation below the mean entry timing. All firms that enter earlier than one standard deviation below the mean are considered to be “leaders.” All firms that enter after one standard deviation below the mean are considered to be “followers.” This point of separation for each cycle examined was examined by a panel of entry timing experts, and each felt the point to be a valid categorization of firms in a dichotomous manner- thus meeting the definition of leaders and followers and cycle characteristics as defined in previous research efforts. Table 4.5 presents the results of our dichotomized breakdown. Figures 4.8 through 4.14 provide histograms detailing the classification system used to categorize the leader and follower categories in this study.

Table 4.5
Leader/Follower Breakdown

	Over All Cycles (n=560)	Cycle 1 (n=122)	Cycle 2 (n=212)	Cycle 3 (n=360)	Cycle 4 (n=208)	Cycle 5 (n=324)	Laptops (n=125)
Mean of Entries#	126.29	72.39	123.01	137.11	180.34	163.91	175.50
Standard Deviation	44.06	29.07	29.92	27.89	14.25	18.53	22.77
Demarcation	82.22	43.32	93.09	109.22	166.09	145.38	152.73
# of Leader Entries	93	20	23	49	27	40	22
# of Follower Entries	467	102	189	311	181	284	125

#in Months Past Jan 1975

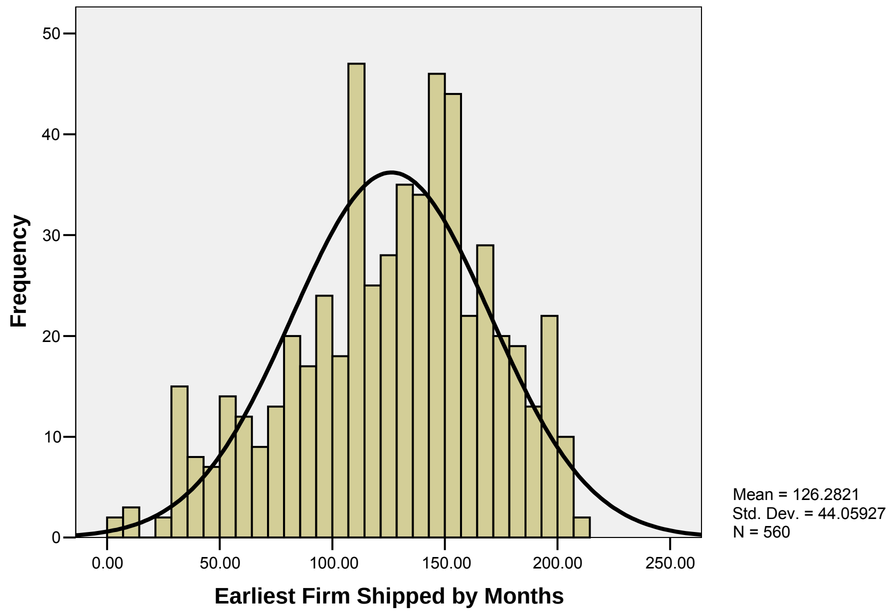


Figure 4.8: Histogram of Firm Entry Timing: Over All Desktop Cycles

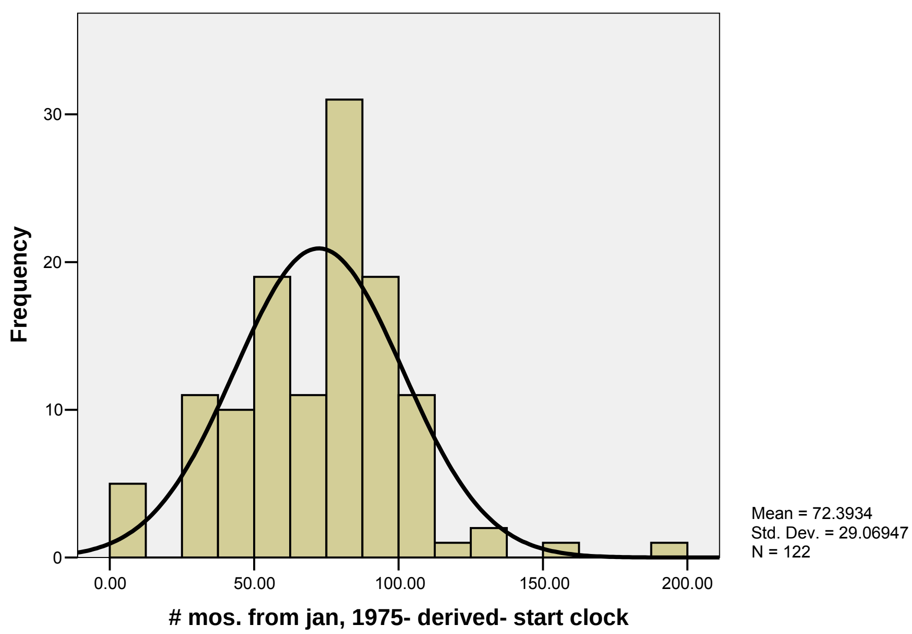


Figure 4.9: Histogram of Firm Entry Timing: Entering 8/8 (Cycle 1) Desktop Cycle

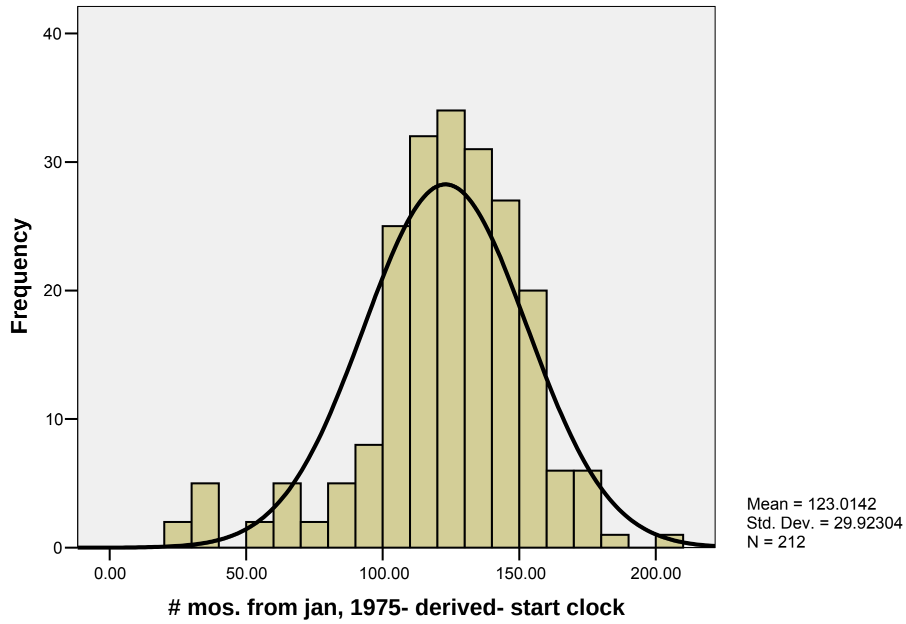


Figure 4.10: Histogram of Firm Entry Timing: Entering 16/8 (Cycle 2) Desktop Cycle

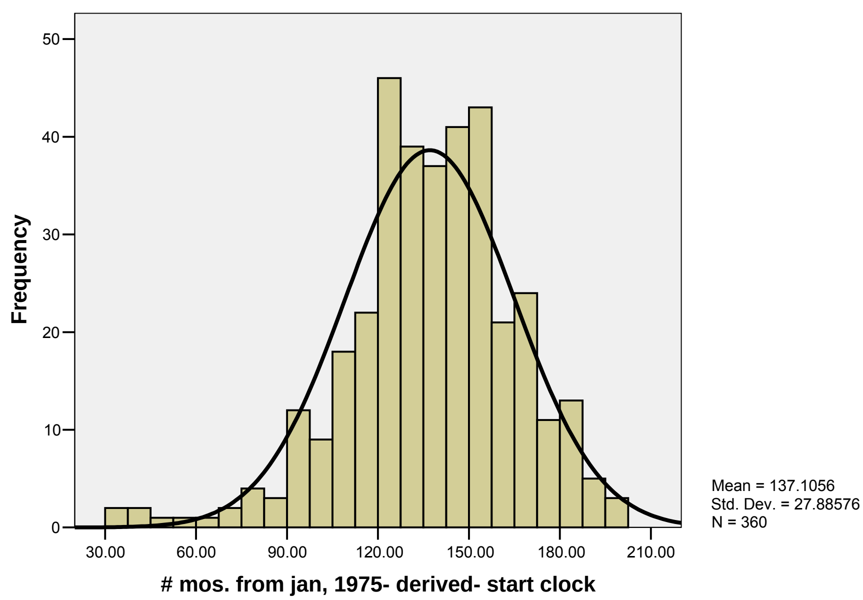


Figure 4.11: Histogram of Firm Entry Timing: Entering 16/6 (Cycle 3) Desktop Cycle

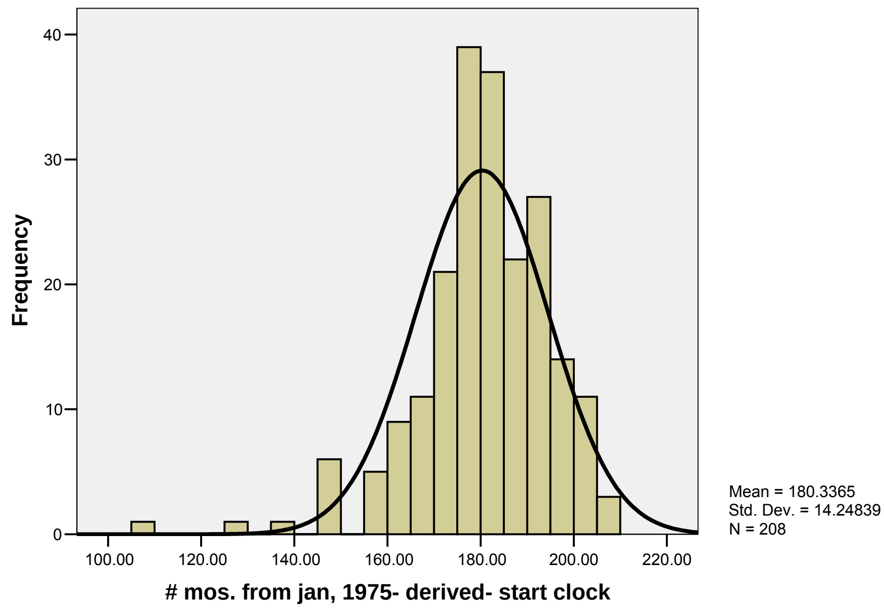


Figure 4.12: Histogram of Firm Entry Timing: Entering 32/6 (Cycle 4) Desktop Cycle

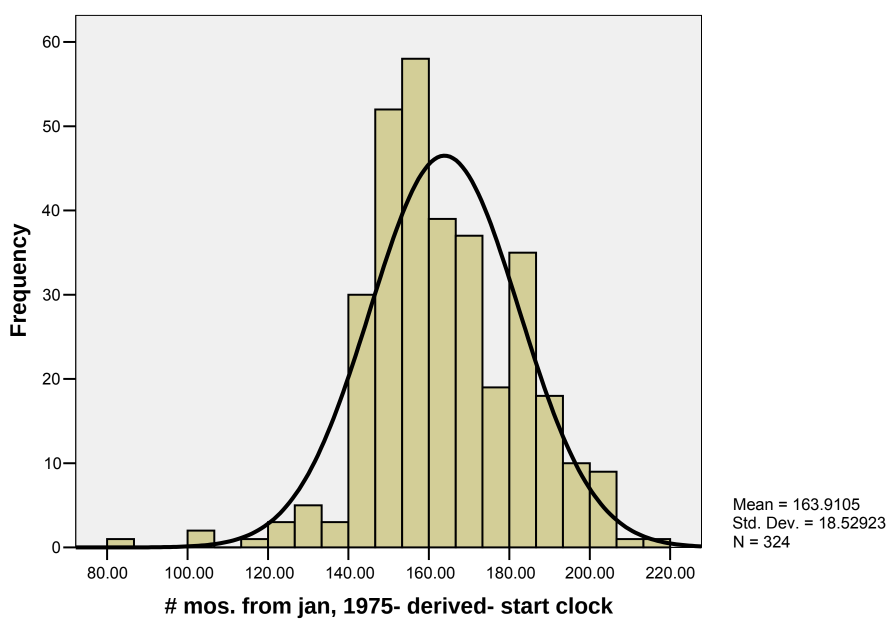


Figure 4.13: Histogram of Firm Entry Timing: Entering 32/2 (Cycle 5) Desktop Cycle

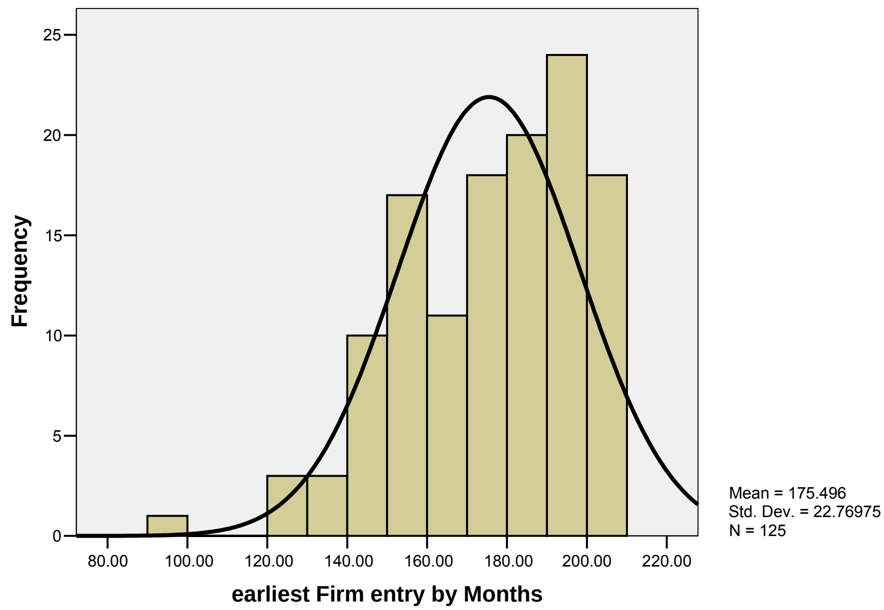


Figure 4.14: Histogram of Firm Entry Timing: Entering Laptop (Cycle 6) Cycle

Continuing on the advice of Lieberman and Montgomery (1988), timing is further parsed out by recording the ranking order of firm entry (1st to enter new cycle, 2nd to enter, 3rd to enter, etc. Entry ties between firms were recoded as an average entry time among those tied firms.) and, to account for deviation size, listing firm entry by the number of absolute months of entry behind the cycle pioneer (defined as the first firm to sell a model of a particular cycle type). Z score of rank entry timing (operationalized by standardizing the entry timing of the firm by cycle in terms of the number of months beyond January of 1975 it entered the cycle.) is also used, as well as a standardized form of the number of months beyond the market pioneer. C**onsistency** of a firm's entry strategy is also measured and used as an independent variable for the hypotheses testing market share and firm survival. The consistency of entry patterns is a firm level variable and was determined by averaging the entry timing patterns of firms over the cycles in which they competed. The formulas for these calculations is as follows:

$$x_{c_1} - x_{c_2}$$

where Xc_1= the entry timing measure for the cycle from which the firm is emerging and Xc_2 is the entry timing measure for the cycle to which the firm is aspiring. At the firm level, the cycle level timing changes are summed and then divided by the number of cycles entered to arrive at an average consistency record for the firm over the cycles in which they competed. That formula is as follows:

$$\sqrt{\frac{\sum (x_{c_1} - x_{c_2})^2}{\#\_of\_cycles}}$$

4.22 Control Variables

New Entrant/ Incumbent: New entrants are defined to be those firms which are leaving from a cycle that was the first PC cycle in which they competed. Therefore, if a firm first entered the PC market offering a 16/8 processor,it would be deemed a new entrant when the measurement for the firm's next cycle is taken (new entrant as measured in the cycle from which the firm is leaving). Incumbents are firms which have previously switched cycles and are thought to be better able to manage incremental technological cycle changes more effectively than new entrants, though they may be less capable of adjusting to architectural changes (Mitchell, 1991). Therefore, to be considered an incumbent, the firm would be entering, at a minimum, its third competition cycle.

Pop Density: Pop density is a measure of the population density at the time of the firm's first entry into the PC industry. Higher density levels are thought to create more firm exits (Carroll & Hannan, 1989; Hannan & Freeman, 1998; Tegarden, Hatfield, & Echols, 1999). This measure is operationalized by taking a count of the number of firms participating in industry in the cycle the firm came from.

Entry Size: Entry size represents the total unit sales for firms in the cycle from which the firm is moving. Larger previous sales by the firm should result in fewer exits as the firm should have more resources and a history of success (Suarez & Utterback, 1995; Tegarden, Hatfield, & Echols, 1999). The entry size variable is operationalized by taking the total unit sales for the firm in the cycle from which the firm is emerging.

Price Premium Firm: This represents the Z score of the firm's average price for a particular cycle from which the firm is moving relative to its competitors in that cycle. Firms that charge higher than average prices are thought to add value to consumers as customers are willing to pay above average prices for a particular producer's products. Thus, the ability to command a price premium represents the possession by the firm of specialized capabilities (Lawless & Anderson, 1996). Porter (1985) theorized that leaders would generally charge higher prices than followers, due to the investments required. Followers may also be able to garner price premiums if they possess marketing capabilities. Price premium is operationalized by first determining the average sales price of a firm's product offering of a particular cycle type, and then standardizing that firm's average price against its competitors of the same model type.

Cycle Completion History: This indicates the number of cycles the firm competed in prior to the current cycle change. For example, if a firm is entering cycle 4 and had previously competed in cycles 1 and 3, Cycle Comp History would = 2 (representing the firm's previous involvement in cycles 1 and 3). Experienced firms have been shown to be more likely to enter new cycles earlier when their current cycle is threatened (Mitchell, 1989). Controlling for cycle completion history aids in isolating the impact made by timing strategies and not the effects of past successes.

Previous Market Share: Previous Market Share represents the average market share earned by the firm in the cycle from which it is leaving. Higher previous market share may lead to greater success (either due to the firm continuing to offer valued offerings, or by the firm being chosen for future investments by industry participants due to previous successes); therefore, to isolate the contributions made by timing, we control for past successes.

Initial Rank Entry and Ending Cycle Rank Entry: Initial Rank Entry represents the ranking of firm entry, relative to all competitors, in the cycle from which the firm is emerging. Ending Cycle Rank entry represents the ranking of the firm in terms of entry in the cycle to which the firm is evolving. These measures are applied to assure that variance measured is not attributed to entry timing in a particular cycle, but rather the accumulated timing efforts of the firm.

LF Firm: LF Firm is a measure of a firm's initial entry timing strategy, measured dichotomously as either a leader or a follower in the firm's first entry into the PC industry. The use of this variable is to ascertain the impact of the collective timing efforts made by the firm, and not those effects attributed to one-time firm actions and results.

4.23 Dependent Variables

Likelihood of Continued Timing: Likelihood of Continued Timing is a measure of the consistency of firm actions over time over multiple technological cycles. Firms that enter successive cycles consistently as leaders would score higher than those firms that enter at times as a leader and at other times as follower. The continued timing measure can also be viewed from the follower's perspective, in that firms that consistently enter as followers will score higher on this measure than those that enter at times as a follower and at times as a leader.

Market Share: Market Share in this research effort is defined in two ways. First, at a cycle level, market share is defined as the percent of the firm's cycle sales to the total same cycle sales for a given year. Second, at an overall firm level, it is defined as the firm's total sales in a given year as compared to the total sales in the industry in the same year. In testing market share, we follow Rumelt's (1991) focus on the business unit effects, rather than the corporate effects of each unit firm. Market share as a measure of firm performance has long been used to determine how a firm's offerings are judged by consumers. Specifically, market share has been found to be a strong approximation of the heterogeneous nature of a firm, as it, by its nature, controls for industry effects (Nelson, 1991; Rumelt, 1991; Schmalensee, 1985). These attributes provide for a valid proxy of firm differences

Market share has been deemed to be an acceptable proxy to measure the results of entry timing (Lieberman & Montgomery, 1988). Prior studies have validated the use of market share to approximate firm profitability. Further, market share has been used by several authors studying timing strategies, including Lambkin (1988), Mitchell (1991), Robinson (1988), and Robinson and Fornell (1985), providing precedence for this study. However, Lieberman and Montgomery caution against the use of market share to imply causality.

Hazard Rate: Survival was identified by Barnard (1938) as the most important goal for firms to achieve. Firm survival has been deemed to be an acceptable proxy to measure the results of entry timing (Lieberman & Montgomery, 1988). Similar to the use of market share as a dependent variable, Lieberman and Montgomery caution against the use of survival to imply causality. In the technology literature, the survival measure has been used by several authors including Carroll, Bigelow, Seidel, and Tsai (1996); Klepper and Simons (2000); Mitchell (1991); Tegarden, Hatfield, and Echols (1999); and Tegarden, Echols, and Hatfield (2000). As measured here, survival is identified by the proxy hazard rate. This rate represents the risk of failure of measured firms.

Tables 4.6 and 4.7 present descriptive statistics for the variables used in this study. Two different levels of variables are used for this study. One set, used for testing the consistency hypotheses (Hypotheses 1a through 1d), are measured at the cycle transformation level. For example, Firm A may sell PCs in three different cycles: PC models utilizing 8/8 microprocessors, PC models utilizing 16/6 microprocessors, and PC models utilizing a 32/6 microprocessor. Each cycle transition, from 8/8 to 16/6 and then 16/6 to 32/6, would be a transaction and provide a point of study to test the hypotheses presented.

LF strategy is a dichotomous variable with a 0 representing a leader strategy and a 1 representing a follower strategy. Each cycle case, Case 1 representing the cycle from which the firm is emerging, and Case 2 which represents the case to which the firm is evolving, is identified and recorded for each cycle change. The mean for Case 1 LF strategy is 0.90 and the mean for Case 2 LF strategy is 0.85. This indicates that, on average, there were generally more leaders in successive cycles, mostly due to more participants in the PC industry as the industry matured.

Other consistency measures, all providing details of both the previous and evolving case (Case 1 and Case 2), are also presented. As indicated, the Z Score average decreased from Case 1 to Case 2, as would be expected, since it standardizes the average Ranking score, which also declined. Further, the Months from Start, measuring the number of months that passed from the introduction of a pioneering effort, as well as its standardized measure, also declined. The declines in entry timing may be indicative of heightened industry competition and shorter windows of entry opportunity for competitors. The market share measures are used to parse our measurement issues associated with the testing of Hypotheses 2a through 2d. These points indicate the evolution of each case's market share over time. The PC industry is fragmented; therefore, market share for any particular firm is very low, as only a few firms hold real market power. Regardless, we can see that the standard deviation for this score is narrowing, again-representing heightened competitive pressures in a maturing market.

An examination of the control variables indicates that new entrants are common to the industry. Operationalized as a dummy variable, a 0 denotes a new entrant and a 1 representing an incumbent firm. We can also see that, on average, firms entered into the PC industry along with approximately 187 other firms, and roughly half of the firms had a history of competing in previous cycles (1.84). Finally, we can see that firms that evolved to future cycles were, on average, more likely to be under the mean for pricing strategy. This is, again, a sign of a highly competitive marketplace.

A second set of data is set at the firm level of analysis. In particular, this dataset is used to test hypotheses regarding market share and hazard rates. For these measures, firm results over the duration of the dataset were aggregated as detailed in the variable definition section. Market share in the firm level statistics represents the firm's average market share over all of its offerings, in all cycle categories. Once again, we see a tightening standard deviation, indicating competitive intensity. As described in the variable overview, the consistency measures are an indication as to the firm's timing efforts over the longitudinal dataset. The shipping in 1988 and shipping in 1991 variables are indicator variables used for the hazard analysis that determines whether the firm was still shipping products during the year in question. A "1" would indicate that all firms survived until the 1988 or 1991 period, while a "0" would indicate that no firm was still shipping at that point. A score of 0.87 and 0.64 indicate that a number of firms failed to continue shipping between those years. Also of note is the average firm price premium over its various offerings, the rank of the firm's first cycle entry (an average of 151.64) and a dichotomous indicator of the firm's first timing strategy. LF=0 would indicate that the firm entered its first cycle as a leader, while LF=1 indicates that the firm entered its first cycle of competition as a follower. Finally, an indicator of whether or not the firm entered into three or more cycles is included. As indicated, more firms than not entered into three or more technological cycles.

Table 4.6
Case Level Descriptive Statistics

	N	Mean	Std. Deviation	Range	
				Minimum	Maximum
Case 1 LF strat	755	0.90	0.30	0.00	1.00
Case 1 Z score	755	0.06	0.93	-3.74	4.08
Case 1 Ranking	755	140.55	91.41	1.50	360.00
Case 1 mths from start	755	88.30	27.67	0.00	185.00
Case 1 standardized 0 entry start measure	755	4.09	1.31	0.00	7.19
Case 2 LF strategy	755	0.85	0.35	0.00	1.00
Case 2 Z Score	755	-0.12	0.93	-5.01	2.70
Case 2 Ranking	755	128.39	86.46	1.00	337.00
Case 2 mths from start	755	76.17	23.05	0.00	151.00
Case 2 standardized 0 entry start measure	755	4.07	1.38	0.00	7.42
Case 1 MS in 1988	401	0.01	0.05	0.00	0.71
Case 1 MS in 1991	419	0.01	0.05	0.00	0.87
Case 2 MS in 1988	419	0.01	0.04	0.00	0.61
Case 2 MS in 1991	517	0.01	0.03	0.00	0.25
Begin= new entrant?	755	0.53	0.50	0.00	1.00
Begin Number of firms competing	755	187.49	67.89	62.00	265.00
Begin Total Unit Sales for Firm	755	82,650.54	438,899.75	5.00	6,738,700.00
Begin Average Z score of Ave price= price premium	755	-0.06	0.96	-1.22	13.73
Number of cycles competed in before this end	755	1.84	0.98	1.00	5.00

Table 4.7
Firm Level Descriptive Statistics

	N	Mean	Std. Deviation	Range	
				Minimum	Maximum
Ave Firm MS in 1988 without Laptops	162	0.01	0.03	0.00	0.40
Ave Firm MS for 1991	242	0.01	0.02	0.00	0.29
Firm Level LF Consistency Measure	359	0.22	0.37	0.00	1.00
Firm Level Rank Consistency Measure	359	102.20	58.15	2.00	312.50
Firm Level Z Score Consistency Measure	359	0.92	0.62	0.01	4.48
Firm Level Mths from Pioneer Consistency Measure	359	30.09	16.40	1.00	86.00
Firm Level Z Mths from Pioneer Consistency Measure	359	1.12	0.88	0.01	5.21
Was firm shipping in 1988	359	0.87	0.34	0.00	1.00
Was firm shipping in 1991	359	0.64	0.48	0.00	1.00
Firm Price Premium= Ave Cycle Prem	359	-0.04	1.07	-1.22	13.73
Rank of first entry of firm	359	151.64	98.06	1.50	360.00
LF strat first entry of firm	359	0.93	0.26	0.00	1.00
Firm with 3 or more cycle changes	359	0.63	0.48	0.00	1.00

A presentation of Pearson correlations for all variables used in this study are presented in tables 4.8.1 through 4.9.2. Tables 4.8.1 and 4.8.2 includes variables measured at the case level, while tables 4.9.1 and 4.9.2 displays variables measured at the firm level. For both sets of correlation statistics, the different methods employed to measure timing are highly correlated to each other. This is to be expected since these measures are measuring the same event, and demonstrate the reliability of the different measurement techniques. As a result, comparisons can be made between the outcomes of the different testing procedures.

Examining the cycle level correlations, it is intriguing to see that the new entry category is generally negatively related to entry timing, suggesting later entry timing by new entrants. Also, the number of firms competing at the time of entry was found to be positively associated with timing, indicating that the more crowded the market at entry the later firms enter, and negatively correlated to market share, demonstrated the difficulty in obtained sales in competitive markets. We also see, consistent with past research, that larger previous sales volume and price premium firms offer firms greater resources, and thus results in earlier entry. Finally, the more history a firm has in the PC industry, the earlier we can expect it to enter into future cycles. Further, we would expect firms with longer cycle histories to be incumbents and to be more likely to have emerged from a less dense competitive environment, a result of participating in a maturing industry.

At the firm level, we see that market share in 1988 is highly correlated with market share in 1991, although later entry in a firm's first cycle appears to lead to lower market share in the 1991 period. This may be due to the firms either being too conservative in market entry and with being faced with a new set of decision choices with the entrance of laptops. Also, firms with 3 or more cycle changes seem to lose ground in terms of entry ranking.

Table 4.8.1
Pearson Correlations for Cycle Level Variables

Case Level Correlations	Case 1 LF strat	Case 1 Z score	Case 1 Ranking	Case 1 mths from start	Case 1 standardized 0 entry start measure	Case 2 LF strategy	Case 2 Z Score	Case 2 Ranking	Case 2 mths from start	Case 2 standardized 0 entry start measure
Case 1 LF strat	1.00									
Case 1 Z score	0.66***	1.00								
Case 1 Ranking	0.46***	0.80***	1.00							
Case 1 mths from start	0.56***	0.87***	0.82***	1.00						
Case 1 standardized 0 entry start measure	0.48***	0.68***	0.58***	0.46***	1.00					
Case 2 LF strategy	0.12***	0.21***	0.19***	0.19***	0.23***	1.000				
Case 2 Z Score	0.13***	0.32***	0.27***	0.24***	0.40***	0.67***	1.000			
Case 2 Ranking	0.12***	0.28***	0.13***	0.24***	0.37***	0.53***	0.81***	1.000		
Case 2 mths from start	0.09**	0.27***	0.062	0.26***	0.15***	0.59***	0.81***	0.86***	1.000	
Case 2 standardized 0 entry start measure	0.10***	0.29***	0.35***	0.32***	0.37***	0.52***	0.73***	0.67***	0.65***	1.000
Case 1 MS in 1988	-0.30***	-0.22***	-0.23***	-0.26***	-0.23***	-0.15**	-0.10*	-0.12*	-0.070	-0.12*
Case 1 MS in 1991	-0.19***	-0.16***	-0.16***	-0.16**	-0.25***	-0.11*	-0.09	-0.085	-0.026	-0.12*
Case 2 MS in 1988	-0.17***	-0.16***	-0.17***	-0.15**	-0.15**	-0.19***	-0.20***	-0.18***	-0.16**	-0.13**
Case 2 MS in 1991	-0.26***	-0.20***	-0.20***	-0.20***	-0.25***	-0.09*	-0.18***	-0.17***	-0.13**	-0.16***
Begin= new entrant?	-0.09**	-0.23***	-0.11**	-0.30***	0.20***	-0.030	-0.040	-0.15***	-0.30***	-0.045
Begin Number of firms competing	0.03	0.08*	0.39***	0.34***	0.15***	0.040	0.000	0.08*	-0.009	0.56***
Begin Total Unit Sales for Firm	-0.26***	-0.19***	-0.16***	-0.19***	-0.22***	-0.040	-0.060	-0.10**	-0.023	-0.054
Begin Average Z score of Ave price= price premium	-0.32***	-0.33***	-0.23***	-0.31***	-0.24***	-0.18***	-0.19***	-0.16***	-0.20***	-0.17***
Number of cycles competed in before this end	-0.07	-0.22***	-0.13***	-0.34***	0.22***	-0.020	-0.03	-0.18***	-0.34***	-0.19***

*** Correlation is Significant at the .001 level
** Correlation is Significant at the .01 level
* Correlation is Significant at the .05 level

Table 4.8.2
Pearson Correlations for Cycle Level Variables

Case Level Correlations	Case 1 MS in 1988	Case 1 MS in 1991	Case 2 MS in 1988	Case 2 MS in 1991	Begin= new entrant?	Begin Number of firms competing	Begin Total Unit Sales for Firm	Begin Average Z score of Ave price= price premium	Number of cycles competed in before this end
Case 1 MS in 1988	1.000								
Case 1 MS in 1991	0.78***	1.000							
Case 2 MS in 1988	0.30***	0.22**	1.000						
Case 2 MS in 1991	0.54***	0.63***	0.62***	1.000					
Begin= new entrant?	0.063	-0.011	0.11*	0.061	1.000				
Begin Number of firms competing	-0.16**	-0.13**	-0.007	-0.12**	0.033	1.000			
Begin Total Unit Sales for Firm	0.56***	0.63***	0.38***	0.83***	0.029	-0.057	1.000		
Begin Average Z score of Ave price= price premium	0.024	-0.010	0.064	0.083	0.067	-0.009	-0.036	1.000	
number of cycles competed in before this end	0.12*	0.030	0.12*	0.11*	0.82***	-0.19***	0.033	0.10**	1.000

*** Correlation is Significant at the .001 level
** Correlation is Significant at the .01 level
* Correlation is Significant at the .05 level

Table 4.9.1
Pearson Correlations for Firm Level Variables

	Ave Firm MS in 1988	Ave Firm MS for 1991	Firm Level LF Consistency Measure	Firm Level Rank Consistency Measure	Firm Level Z Score Consistency Measure	Firm Level Mths from Pioneer Consistency Measure
Ave Firm MS in 1988	1.00					
Ave Firm MS for 1991	0.83***	1.00				
Firm Level LF Consistency Measure	0.09	0.10	1.00			
Firm Level Rank Consistency Measure	-0.13	-0.18**	-0.02	1.00		
Firm Level Z Score Consistency Measure	-0.02	-0.03	0.54***	0.36***	1.00	
Firm Level Mths from Pioneer Consistency Measure	0.01	-0.06	0.32***	0.60***	0.63***	1.00
Firm Level Z Mths from Pioneer Consistency Measure	0.13	0.06	0.34***	0.08	0.36***	0.26***
Was firm shipping in 1988	na	0.02	-0.04	0.31***	-0.07	0.07
Was firm shipping in 1991	0.13	0.06	-0.06	0.25***	0.00	0.02
Firm Price Premium= Ave Cycle Prem	-0.06	-0.06	-0.02	0.05	0.03	0.02
Rank of first entry of firm	-0.23**	-0.22***	-0.35***	0.45***	-0.10	0.33***
LF strat first entry of firm	-0.33***	-0.40***	-0.34***	0.08	-0.31***	-0.20***
Firm with 3 or more cycle changes	0.13	0.13*	0.11*	0.18***	0.04	0.06

*** Correlation is Significant at the .001 level
** Correlation is Significant at the .01 level
* Correlation is Significant at the .05 level

Table 4.9.2
Pearson Correlations for Firm Level Variables

	Firm Level Z Mths from Pioneer Consistency Measure	Was firm shipping in 1988	Was firm shipping in 1991	Firm Price Premium= Ave Cycle Prem	Rank of first entry of firm	LF strat first entry of firm	Firm with 3 or more cycle changes
Firm Level Z Mths from Pioneer Consistency Measure	1.00						
Was firm shipping in 1988	0.12*	1.00					
Was firm shipping in 1991	0.16**	0.52***	1.00				
Firm Price Premium= Ave Cycle Prem	0.03	0.00	-0.05	1.00			
Rank of first entry of firm	-0.28***	0.26***	0.23***	-0.06	1.00		
LF strat first entry of firm	-0.30***	0.08	0.06	0.00	0.40***	1.00	
Firm with 3 or more cycle changes	0.24***	0.29***	0.27***	0.03	-0.01	0.05	1.00

*** Correlation is Significant at the .001 level
** Correlation is Significant at the .01 level
* Correlation is Significant at the .05 level

4.3 HYPOTHESES TESTING

Table 4.10 presents an overview of the variables employed in this study, the hypotheses associated with the variables, as well as the statistical methods used to test each relationship. In this section, each hypothesis will be presented along with a description as to how it is tested.

4.31 Consistency Hypotheses

For hypotheses 1(a) and 2(a), the consistency of firm actions over time is measured. The hypotheses predict:

H1a: Leaders are more likely to be leaders again when facing successive incremental innovation cycle changes.

H1b: Followers are more likely to be followers again when facing successive incremental innovation cycle changes.

Key to the testing of these hypotheses is the measuring of the timing entry terms “leaders” and “followers.” To parse out the sensitivity of measurement, and thus the definition of each of these terms, timing will be operationalized at multiple points along the measurement scale. At one extreme, entry timing will be measured dichotomously. As such, each firm entry will be classified as a “leadership” entry should the firm enter into a cycle in less than one standard deviation below the mean entry time for a particular cycle, and as a “follower” should a firm enter after that demarcation point. Entry timing is then examined at the ordinal level with the employment of rank entry, at the interval level with the Z score of entry timing and the standardized measure of number of months behind the pioneer entry measure, and at the ratio level with the number of months behind the entry of the pioneer measure. Clarity can be brought to the question of entry timing definition with the comparison of the multiple measurements used.

To test the dichotomous "leader/follower" entry timing measure, logistic regression is employed. Logistic regression is a preferred test when dealing with a binary dependent variable. Unlike normal regression analysis, where each regressor's coefficient measures a contribution to the dependent variable, regressors in a logistical analysis indicate a change in the probability that the dependent variable will be either a 0 or 1, in this case a leader (0) or a follower (1). To form a "best fit" equation, logistic regression utilizes a maximum likelihood method instead of the least-squared deviation that is used in ordinary regression. Thus, for testing the data here, we are fitting the data to the equation:

$$\text{Logit}(p(\text{Case 2 LF})) = a + b_1(\text{New Entrant}) + b_2(\text{Pop Density}) + b_3(\text{Entry Size}) + b_4(\text{Price Premium}) + b_5(\text{Cycle Comp History}) + b_6(\text{Case 1 LF}) + e.$$

where the probability of the successive entry case will be that of a follower (1) = to the impact of being a new entrant in the previous cycle, along with the impact on the firm of its initial entry population density, along with the impact of the firm's size at initial entry, along with the impact of its pricing policies, along with the history of cycle competition, along with the impact of the firm's timing entry in its previous cycle. While previous research results lead to the inclusion of the control variables included, we are interested on the impact of the previous case entry timing strategy on the successive entry strategy.

Other measurements of entry timing are tested using ordinary least squares regression. Resulting equations are as follows:

Rank Entry in Cycle 2= a + b_1(New Entrant) + b_2(Pop Density) + b_3(Entry Size) + b_4(Price Premium) + b_5(Cycle Comp History) + b_6(Case 1 Rank Entry) + e;

Z Score of Entry in Cycle 2= a + b_1(New Entrant) + b_2(Pop Density) + b_3(Entry Size) + b_4(Price Premium) + b_5(Cycle Comp History) + b_6(Case 1 Z Score) + e;

Months from Pioneer in Cycle 2= a + b_1(New Entrant) + b_2(Pop Density) + b_3(Entry Size) + b_4(Price Premium) + b_5(Cycle Comp History) + b_6(Case 1 Months from Pioneer in Cycle 1) + e;

Standardized Months from Pioneer in Cycle 2= a + b_1(New Entrant) + b_2(Pop Density) + b_3(Entry Size) + b_4(Price Premium) + b_5(Cycle Comp History) + b_6(Case 1 Standardized Months from Pioneer in Cycle 1) + e.

Regression analysis is used to predict the variance of a variable dependent on regressors. For each regression run described, both logistic and standard regression, terms were entered in a hierarchical manner such that the control variables of new entrant, population density, entry size, and pricing strategy were entered as a first model, the firm's cycle completion history was added as a second model, and finally the independent variable representing the initial timing effort was entered. In a hierarchical multiple regression, the researcher, guided by theory, introduces the entry order of variables to the regression equation. An F-test is then used to determine the significance of variables added at each successive level of the hierarchy. While the entry rank timing is classified as an ordinal variable, since the number of categories exceeds seven, we can be reasonably assured that we will obtain a normal distribution of error (Berry, 1993). This allows us to use our ordinal ranking data as a dependent variable in our multiple regression analyses. Scatterplots of all firm entry timing changes are located in Appendix C.

Moderating effects of initial entry timing strategy and competitive history were accounted for. Initial strategy timing efforts are considered to be an indication of management strategy intent: whether as a firm that intends to pursue leadership or follower ends. Firms that entered its first PC cycle as a leader were considered to be a "leader" firm. If it entered in its first cycle as a follower, it was deemed a "follower" firm. Finally, firms that are more active in switching cycles may moderate the relationship tested, in that firms that compete in multiple cycles may be an indication of management focus on innovation. Therefore, we further test our models against the "multi-cycled" firms: those firms that have entered into three or more cycles, thus switching two or more times. Further, sub-samples were created and regression equations were applied to each cycle in isolation to determine if cycle differences, representing industry evolution, have any impact on our results. Of particular focus for Hypotheses 1a and 1b are the results stemming from firms leaving their initial cycle entry times and entering either the 16/8 (Cycle 2), 16/6 (Cycle 3), 32/6(Cycle 4), or 32/2 (Cycle 5) cycles. These cycle changes represent incremental innovation changes in the PC industry for the data years included in this study.

The techniques used to test Hypotheses 1a and 1b were then replicated to test Hypotheses 1c and 1d. As stated, these hypotheses are:

H1c: Leaders are less likely to be leaders again when facing architectural innovation cycle changes.

H1d: Followers are more likely to be followers again when facing architectural innovation cycle changes.

The only difference in the testing of Hypotheses 1a and 1b and 1c and 1d is the cycle sub-sample against which the regression tests are applied. To test Hypotheses 1c and 1d, entry consistency measures are taken for firms as they move from incremental industry changes (from cycle to cycle) to an architectural change in the form of laptop computers.

The variance-inflation factor (VIF) statistic was used to check for multicollinearity of the independent variables used in the various models. Acceptable VIF levels are below 10.0, while below 5.0 are preferred. VIF statistics for the models tested show that multicollinearity is not an issue, with all VIF statistics scoring below the 5.0 level.

4.32 Market Share Hypotheses

For Hypotheses 2a, 2b, 2c, and 2d, we examined the effect consistency of timing entry has on a firm's market share. Repeated here, these hypotheses predict:

H2a: Leaders that repeat as leaders will realize higher market share than those leaders that switch to follower patterns during incremental technological changes.

H2b: Followers that repeat as followers will realize higher market share than those followers that switch to leader patterns during incremental technological changes.

H2c: Leaders that repeat as leaders will realize lower market share than those leaders that switch to follower patterns when faced with architectural technological changes.

H2d: Followers that repeat as followers will realize higher market share than those followers that switch to leader patterns when faced with architectural technological changes.

Testing of these hypotheses depends on properly identifying the impact of consistency strategy on market share. The objective is to determine if consistency of firm timing actions lead to the firm's ability to capture greater market share. Of particular concern in our testing of market share is the impact of timing consistency on both the movement from one cycle to the next, as well as the longer term impact of the timing patterns on the firm. For this reason, the hypotheses are tested by examining a cycle to cycle relationship, which isolates and studies firm strategy impact one cycle change to another, as well as a firm level relationship, encompassing overall firm market share impacts.

First, we will examine consistency of firm timing actions on market share obtained from one cycle to another. In testing a cycle to cycle model, we must be careful to isolate our variable of interest: firm sequential timing consistency, which is a measure of a firm's overall timing consistency results. As with our previous test of firm consistency behavior, all different measures of consistency are tested in the testing of the market share hypotheses (Leader/Follower dichotomized, Rank Entry Order, Z Score Entry Timing, Months after Pioneer Entry, and Standardized Months after Pioneer Entry). To isolate the effects of the timing regressors, several control variables were included which have been shown in previous studies to influence market share. Specifically, we controlled for the firm's previous cycle market share; the firm's pricing strategy, since higher priced firms are thought to indicate value provided to consumers; and the rank entry of the firm into the successive cycle, since research has shown that entry timing does affect market share within a cycle. Further, to determine if there are industry life cycle impacts, in that as the industry matures competition will be increased and make it more difficult to obtain market share, indicator variables for each cycle were also included. Expressed as a linear equation, the resulting regression statistic will take the following form:

Market Share Obtained in Cycle 2= a + b_1(Case 1 Market Share) + b_2(Price Premium) + b_3(Ending Cycle Rank Entry) + b_4(Cycle 2) + b_5(Cycle 3) + b_6(Cycle 4) +b_7(Cycle 5) +b_8(Cycle 6) +b_9(Firm Sequential Consistency)+ e.

Cycle market share will be measured at two separate times to determine if laptop entry (an architectural impact) had any effects on the firm market share. To accomplish this, firm average market share of all of its model offerings for a particular cycle type will be measured in 1988 and then again in 1991. As an example, if a firm moved from cycle 2 to cycle 4, we would obtain the following regression equations:

Market Share Obtained in 1988 for Cycle 4= a + b_1(Cycle 2 Market Share in 1988) + b_2(Price Premium) + b_3(Cycle 4 Rank Entry) + b_4(Cycle 2) + b_5(Cycle 3) + b_6(Cycle 4) +b_7(Cycle 5) +b_8(Cycle 6) +b_9(Firm Sequential Consistency)+ e.

Market Share Obtained in 1991 for Cycle 4= a + b_1(Cycle 2 Market Share in 1991) + b_2(Price Premium) + b_3(Cycle 4 Rank Entry) + b_4(Cycle 2) + b_5(Cycle 3) + b_6(Cycle 4) +b_7(Cycle 5) +b_8(Cycle 6) +b_9(Firm Sequential Consistency)+ e.

Finally, to test the differences between firms that are "leaders" and those that are "followers," we tested each separately. As described in the Variables section, leaders are considered to be those firms that entered into their first cycle of competition as a "leader" as defined by our dichotomous leader/follower categorization, while "follower" firms are those firms that entered into their first cycle as a "follower."

We continued the leader/follower categorization for moderation at the firm level. Also at the firm level, market share results are measured in both 1988 and 1991. However, a key difference with this model is our view of the "cycle." In this instance, we are testing the market share variables as if all cycle entries are but products of an overall industry evolution. Instead of market share being the result of total firm efforts on one particular cycle, market share is measured as the total firm market share over all cycles in which it is participating, relative to all other participants in the industry at those times. Further, with the testing of firm level market share, we do not want to include successive rank order as a control variable, but instead the firm's initial entry rank order. As a result, the following linear regression equations are obtained:

Firm Market Share Obtained in 1988= a + b_1(Price Premium) + b_2(Initial Rank Entry) + b_3(Firm Sequential Consistency) + e.

Firm Market Share Obtained in 1991= a + b_1(Price Premium) + b_2(Initial Rank Entry) + b_3(Firm Sequential Consistency) + e.

As with the cycle to cycle tests, the 1991 market share is included to test the impact of architectural change on the firm. To test for multicolinearity of the independent variables and control variable variance-inflation factor (VIF) statistic was employed. Acceptable VIF levels (below the 5.0 level) were recorded.

4.33 Hazard Rate Hypotheses

The following hypotheses have been proposed to test the hazard rate association with different levels of firm timing consistency efforts:

H3a: Leaders that repeat as leaders will realize lower hazard rates than those leaders that switch to follower patterns during incremental technological changes.

H3b: Followers that repeat as followers will realize lower hazard rates than those followers that switch to leader patterns during incremental technological changes.

H3c: Leaders that repeat as leaders will realize higher hazard rates than those leaders that switch to follower patterns when faced with architectural changes.

H3d: Followers that repeat as followers will realize lower hazard rates than those followers that switch to leader patterns when faced with architectural changes.

Hazard rates denote the amount of risk imposed from the introduction of independent variables (StatSoft, 2003). As such, it can be viewed as an opposing or counter statistic to survival. Cox Proportional Hazard Regression analysis is used in this study to measure the risk associated with not pursuing a consistent entry timing strategy (Cox & Oakes, 1984). Specifically, Hypotheses 3a and 3b will be supported if we find a higher hazard rate attributed to firms not pursuing consistent timing strategies during incremental cycle changes. Therefore, a lower hazard rate will be achieved by those firms achieving a consistent entry strategy, and thus greater chance at firm survival. The Cox hazard calculation requires that the firm's longevity in the market be indicated, as well as an indicator for the end time of the study. A firm's total number of months producing PCs was entered for firm longevity, and 1988 was used as the terminal point of the study. Of the 359 firms that shipped from 1975 to 1988, 311 were still shipping in 1988 (86.6%). Firms averaged a duration of 61.53 months of shipping in the industry (s.d.= 38.10).

The independent variable to be tested in Hypotheses 3a through 3d is the same consistency variables used in the testing of the market share hypotheses (2a through 2d). Control variables utilized include the firm's pricing strategy, whether or not the firm engaged in three or more cycle changes, the initial timing strategy employed by the firm (whether a leader or a follower), and the firm's initial rank entry. As with the previous models, a hierarchical entry method is used where the control variables are first entered and the timing consistency variable is entered secondly.

Hazard rates associated with timing consistency will be computed first for the full sample. Then, in order to determine if the rates differ for those firms entering the laptop cycles versus those firms that do not, each of these competitive types will be tested alone. In separating these hazards away from the main grouping, we will be able to discern the hazards associated with firm timing consistency within the incremental cycles, and those hazards associated with entering an architectural cycle (laptops).

Table 4.10
Summary of Predicted Relationships

	Dependent Variables			
Independent Variables	Likelihood of Continued Entry Timing Strategy	Market Share	Hazard Rate (Incremental)	**Method**
Leadership Entry Timing (Incremental)	H1a (+)			Dichotomous: Logistic Regression Continuous: Multiple Regression CVs: Incumbent/New Entrant, Time of Entry Population Density, Firm Size at Entry, Firm Pricing Strategy, Cycle Competition History.
Leadership Entry Timing (Architectural)	H1c (-)			
Followership Entry Timing (Incremental)	H1b (+)			Dichotomous: Logistic Regression Continuous: Multiple Regression CVs: Incumbent/New Entrant, Time of Entry Population Density, Firm Size at Entry, Firm Pricing Strategy, Cycle Competition History.
Followership Entry Timing (Architectural)	H1d (+)			
Consistent Leadership (Incremental)		H2a(+)	H3a(-)	Market Share: Multiple Regression CVs: Previous Market Share, Firm Pricing Strategy, Initial Rank Order, Ending Cycle Rank Order. Survival: Cox Hazard Regression CVs: Firm Pricing Strategy, Cycle Competition History, Initial Entry Strategy, Initial Rank Entry Order.
Consistent Leadership (Architectural)		H2c(-)	H3c(+)	
Consistent Followership (Incremental)		H2b(+)	H3b(-)	Market Share: Multiple Regression CVs: Previous Market Share, Firm Pricing Strategy, Initial Rank Order, Ending Cycle Rank Order. Survival: Cox Hazard Regression CVs: Firm Pricing Strategy, Cycle Competition History, Initial Entry Strategy, Initial Rank Entry Order.
Consistent Followership (Architectural)		H2d(+)	H3d(-)	

5.0 RESULTS

5.1 Consistency Hypotheses Results

The first research question that this research project is seeking answers for is whether engaging in certain initial timing strategies make firms more likely to follow similar timing strategies in the future. Several hypotheses stem from this question and will be tested in the following section. For Hypotheses 1a through 1d, several measures of firm timing will be utilized so that measurement sensitivity of the construct can be determined. Specifically, each of these hypotheses will utilize a dichotomous leader/follower measure, an ordinal rank entry timing measure, a z-score of the rank entry timing measure intended to smooth out variation of the rank order construct, a continuous measure of months of entry behind the cycle pioneer, and finally a standardized measure of number of months behind the pioneer entry date. The results of each of these measurements will be discussed. The first hypotheses to be tested are:

H1a: Leaders are more likely to be leaders again when facing successive incremental innovation cycle changes.

and

H1b: Followers are more likely to be followers again when facing successive incremental innovation cycle changes.

The PC industry experienced five incremental cycle changes from the years 1974 to 1991. As measured by the multiprocessor attributes, these cycles included an 8/8 cycle, a 16/8 cycle, a 16/6 cycle, a 32/6 cycle, and finally a 32/2 cycle. To test the hypotheses, we will examine, at a cycle level, whether or not the entry timing in one cycle influenced the firm in its entry timing in successive incremental cycles. Key to this test is the way in which entry timing is measured. As a result, we will utilize five different timing measurement techniques to parse out measurement influences. Also controlled for in our measurements in order to isolate the previous timing strategy, are the history of firm industry behaviors. Specifically, for each test we study separately those firms starting as leaders in their first cycle of entry, those firms starting as followers in their first cycle of entry, those multi-cycled firms (those that have entered into three or more cycles previous to this entry change), and the interactions of the initial strategy with multi-cycled firms. Firms entry timing into its first PC cycle is used here as an indication as to what its timing strategy is meant to be. Therefore, firms that entered first as a leader are considered to be leader firms, while those that enter first as follower are thought to be follower firms. The rationale behind this classification is that initial entry timing is a result of firm investments into unique resources and capabilities. Those commitments are assumed to be entered into in a logical fashion and can thus be considered as a de-facto strategic position taken by firm management.

The first cycle timing measurement to be tested is a dichotomous one: Leader/Follower. Again, leaders are those firms which enter into a cycle earlier than one standard deviation below the mean entry timing for that cycle. To test this dichotomized construct, we employ logistical analysis. Unlike regular regression were we determine the impact of regressors on the value of a dependent variable, logistical analysis predicts the probability of an outcome based on the inclusion of certain influencers. In our study, we want to know what the probability of being a leader based on a firm's being a leader in the immediate previous cycle in which the firm completed, and vice-versa what the probability of being a follower is assuming one was a follower in previous cycles. The control variables of new entrant, population density, entry size, and pricing strategy are entered and modeled first. Next we enter cycle completion history as a control variable because we want to make sure we isolate the previous timing strategy, our variable of interest, This previous timing strategy variable is entered on the third step of the hierarchical pattern.

In our logistical model, the dependent variable of case 2 entry timing is an indicator variable where a "0" represents a leader, and a "1" represents a follower. Crosstabs indicating expected versus the actual timing outcomes from the data are included in Table 5.1. Tables 5.2 through 5.5 represent the actual versus expected outcomes when isolating each incremental entry cycle (For example, Cycle 4 represents only those cases in which firms entered cycle 4 (32/6). These entrants may have come from cycles 1, 2, or 3 as an immediate previous step). The actual number of leaders that were able to be leaders again in the successive cycle was higher than anticipated from the model, just as a higher percent of follower firms were followers again.

Table 5.1
Actual versus Expected Counts of Leader/Follower Entries Over all Cycles

Case 1 LF strat * Case 2 LF strategy Crosstabulation

			Case 2 LF strategy		
			0	1	Total
Case 1 LF strat	0	Count	22	56	78
		Expected Count	11.3	66.7	78.0
		% within Case 1 LF strat	28.2%	71.8%	100.0%
		% within Case 2 LF strategy	19.8%	8.6%	10.2%
		% of Total	2.9%	7.3%	10.2%
	1	Count	89	597	686
		Expected Count	99.7	586.3	686.0
		% within Case 1 LF strat	13.0%	87.0%	100.0%
		% within Case 2 LF strategy	80.2%	91.4%	89.8%
		% of Total	11.6%	78.1%	89.8%
Total		Count	111	653	764
		Expected Count	111.0	653.0	764.0
		% within Case 1 LF strat	14.5%	85.5%	100.0%
		% within Case 2 LF strategy	100.0%	100.0%	100.0%
		% of Total	14.5%	85.5%	100.0%

Table 5.2
Actual versus Expected Counts of Leader/Follower Entries Cycle 2 Ending Cycle

Case 1 LF strat * Case 2 LF strategy Crosstabulation

			Case 2 LF strategy		
			0	1	Total
Case 1 LF strat	0	Count	2	5	7
		Expected Count	1.4	5.6	7.0
		% within Case 1 LF strat	28.6%	71.4%	100.0%
		% within Case 2 LF strategy	22.2%	13.9%	15.6%
		% of Total	4.4%	11.1%	15.6%
	1	Count	7	31	38
		Expected Count	7.6	30.4	38.0
		% within Case 1 LF strat	18.4%	81.6%	100.0%
		% within Case 2 LF strategy	77.8%	86.1%	84.4%
		% of Total	15.6%	68.9%	84.4%
Total		Count	9	36	45
		Expected Count	9.0	36.0	45.0
		% within Case 1 LF strat	20.0%	80.0%	100.0%
		% within Case 2 LF strategy	100.0%	100.0%	100.0%
		% of Total	20.0%	80.0%	100.0%

Table 5.3
Actual versus Expected Counts of Leader/Follower Entries Cycle 3 Ending Cycle

Case 1 LF strat * Case 2 LF strategy Crosstabulation

			Case 2 LF strategy 0	Case 2 LF strategy 1	Total
Case 1 LF strat	0	Count	5	12	17
		Expected Count	2.4	14.6	17.0
		% within Case 1 LF strat	29.4%	70.6%	100.0%
		% within Case 2 LF strategy	20.0%	7.8%	9.5%
		% of Total	2.8%	6.7%	9.5%
	1	Count	20	142	162
		Expected Count	22.6	139.4	162.0
		% within Case 1 LF strat	12.3%	87.7%	100.0%
		% within Case 2 LF strategy	80.0%	92.2%	90.5%
		% of Total	11.2%	79.3%	90.5%
Total		Count	25	154	179
		Expected Count	25.0	154.0	179.0
		% within Case 1 LF strat	14.0%	86.0%	100.0%
		% within Case 2 LF strategy	100.0%	100.0%	100.0%
		% of Total	14.0%	86.0%	100.0%

Table 5.4
Actual versus Expected Counts of Leader/Follower Entries Cycle 4 Ending Cycle

Case 1 LF strat * Case 2 LF strategy Crosstabulation

			Case 2 LF strategy 0	Case 2 LF strategy 1	Total
Case 1 LF strat	0	Count	3	10	13
		Expected Count	1.9	11.1	13.0
		% within Case 1 LF strat	23.1%	76.9%	100.0%
		% within Case 2 LF strategy	13.0%	7.2%	8.1%
		% of Total	1.9%	6.2%	8.1%
	1	Count	20	128	148
		Expected Count	21.1	126.9	148.0
		% within Case 1 LF strat	13.5%	86.5%	100.0%
		% within Case 2 LF strategy	87.0%	92.8%	91.9%
		% of Total	12.4%	79.5%	91.9%
Total		Count	23	138	161
		Expected Count	23.0	138.0	161.0
		% within Case 1 LF strat	14.3%	85.7%	100.0%
		% within Case 2 LF strategy	100.0%	100.0%	100.0%
		% of Total	14.3%	85.7%	100.0%

Table 5.5
Actual versus Expected Counts of Leader/Follower Entries
Cycle 5 Ending Cycle

Case 1 LF strat * Case 2 LF strategy Crosstabulation

			Case 2 LF strategy		
			0	1	Total
Case 1 LF strat	0	Count	9	24	33
		Expected Count	4.1	28.9	33.0
		% within Case 1 LF strat	27.3%	72.7%	100.0%
		% within Case 2 LF strategy	25.7%	9.8%	11.7%
		% of Total	3.2%	8.5%	11.7%
	1	Count	26	222	248
		Expected Count	30.9	217.1	248.0
		% within Case 1 LF strat	10.5%	89.5%	100.0%
		% within Case 2 LF strategy	74.3%	90.2%	88.3%
		% of Total	9.3%	79.0%	88.3%
Total		Count	35	246	281
		Expected Count	35.0	246.0	281.0
		% within Case 1 LF strat	12.5%	87.5%	100.0%
		% within Case 2 LF strategy	100.0%	100.0%	100.0%
		% of Total	12.5%	87.5%	100.0%

With cursory evidence that leaders are more likely to be leaders, the logistical analysis is conducted. Significance was tested as a one-tailed test with a p value of less than 0.05. Logistical analysis results are reported in Tables 5.6.1 through 5.10.2. Collinearity between our independent and control variables was checked using the VIF statistic. No interaction was above the 5.0 VIF level, indicating that collinearity between our variables were within acceptable limits. In the full model, we see that price premium strategy is significant in the full model, as well as with those firms that started either as a leader or follower in their initial strategy. This implies that price premium firms are more likely to have entered as a follower. When a finer-grained analysis is conducted, we see that the ability to charge a premium price appears to be most important early in the industry evolution, as this variable is significant in cycles 2 and 3 but not in later cycles. This makes sense in that the ability to charge a premium price is an indication of value added, and these firms were probably those firms that possessed more complementary assets, which may very well be in the form of channels of distribution- a requirement for followers. Entry size is also found to be significant cycle 3, indicating that firms with larger assets tended to gravitate towards the follower strategies. This, along with the price premium finding, fits previous literature as it is those firms with larger asset and marketing bases that are most able to pursue followership strategies.

Most supportive of our hypothesis, is that we find general support that the previous cycle timing entry, Case 1 LF, is an indicator of a firm's future cycle entry probability. While not statistically significant in the full model or cycle 4, we do find significance in every multi-cycled, follower, and follower*multi-cycle model. We also do not find significance in any leader or leader*multi-cycled model, this result, however, is suspect in that the sample size is so small in many of the models.

Of particular importance is the direction of significance in our model. Specifically, we see a negative relationship in all of our models except those in cycle 3, in which we see a positive relationship between entry timing indication probabilities. The negative relationships indicate a reduced probability to switch entry timing strategies. The negative relationships range from a low extreme of -1.38 in cycle 5's follower*multi-cycled outcome to a high of -0.68 found in the overall model's multi-cycled model. The -1.38 indicates that for multi-cycled firms, there is a 74.7% decrease in the odds of that firm switching from being a follower in cycles before entering cycle 5 to a leader timing strategy in cycle 5. The -0.68 indicates a unique contribution of a 49.2% decrease in the probability that the firm will become a leader when the firm was involved in multiple cycles. The cycle 5 follower*multi-cycled model, when expressed in linear terms is as follows:

Log(p(follower)/1-p)= -6.12 – 1.38 (Case 1 L/F) - .01 (Population Density).

Cycle 3 results counter the other results. In cycle 3 we see high of 8.84 (found in the follower*multi-cycle model) and a low of 2.37 (from the full cycle 3 model). We therefore see a greater probability of firms switching strategies in this cycle. The 8.84 measure results in the following equation:

Log(p(follower)/1-p) = -3.61 + 8.84(Case 1 L/F) + 1.89(New Entrant) + .02(Pop Density) – 2.78 (Price Premium).

The inconsistent results that we have found demonstrate that our breaking down and examining each cycle stage in isolation is a significant contribution to the research in timing studies. If we had only studied the industry as a whole, we would not understand the dynamic competition as well. Overall, however, the leader/follower testing here, while more supportive of the claim that followers are more likely to be followers, is inconclusive in the testing of Hypothesis H1a.

Table 5.6.1
Test of Hypotheses 1a and 1b
Logistic Regression
Leader/Follower Dichotomy Cycles 1-5

DV= Case 2 LF	Full Models (n=661)			Leader 1st Entry Models (n=49)			Multi-Cycled Firm Models (n=536)		
	1	2	3	1	2	3	1	2	3
Intercept	1.30^{**}	0.74	0.79	0.85	-0.28	-0.79	1.45^{***}	0.96	1.05
New Entrant?	0.18	0.50	0.48	-0.05	0.64	-0.74	0.12	0.38	0.35
Pop Density	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
Entry Size	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Price Premium Firm	-0.61^{***}	-0.61	-0.59	-0.46^{*}	-0.45	-0.60	-0.48^{**}	-0.49	-0.43
Cycle Comp History		0.22	0.21		0.46	0.64		0.19	0.17
Case 1 LF			-0.17			2.21			-0.34
chi^2	31.42^{***}	0.62	0.21	9.09^{*}	0.29	2.36	12.46^{**}	0.45	0.67
-2 Log Likelihood	501.98	501.36	501.15	47.61	47.32	44.96	425.13	424.68	424.01

One-Tailed Test:

p < .05

p < .01

p < .001

Table 5.6.2
Test of Hypotheses 1a and 1b
Logistic Regression
Leader/Follower Dichotomy Cycles 1-5

DV= Case 2 LF	Leader & Multi-Cycled Firm Models (n=38)			Follower 1st Entry Models (n=612)			Follower & Multi-Cycled Firm Models (n=498)		
	1	2	3	1	2	3	1	2	3
Intercept	-0.45	-1.55	-1.70	1.40^{**}	0.94	1.02	1.68^{**}	1.33	-1.47
New Entrant?	0.40	1.05	-0.11	0.19	0.44	0.37	0.10	0.28	0.19
Pop Density	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Entry Size	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Price Premium Firm	-0.29	-0.28	-0.46	-0.72^{***}	-0.73	-0.68	-0.57^{**}	-0.58	-0.48
Cycle Comp History		0.44	0.62		0.18	0.17		0.13	0.11
Case 1 LF			1.81			-0.38			-0.55
chi^2	4.25	0.29	1.40	17.96^{***}	0.37	0.66	7.84^{*}	0.19	1.34
-2 Log Likelihood	37.35	37.07	35.66	452.84	452.47	451.82	385.50	385.31	383.97

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

Table 5.7.1
Test of Hypotheses 1a and 1b
Logistic Regression
Leader/Follower Dichotomy Entering Cycle 2

DV= Case 2 LF	**Full Models (n=45)**			**Leader 1st Entry Models (n=7)**			**Multi-Cycled Firm Models (n=32)**		
	1	2	3	1	2	3	1	2	3
Intercept	1.52**	1.52	1.48	-	-	-	1.24*	1.24	1.26
New Entrant?	-	-	-	-	-	-	-	-	-
Pop Density	-	-	-	-	-	-	-	-	-
Entry Size	0.00	0.00	0.00	-	-	-	0.00	0.00	0.00
Price Premium Firm	-1.25*	-1.25	-1.38	-	-	-	-0.94*	-0.94	-0.88
Cycle Comp History		-	-		-	-		-	-
Case 1 LF			1.05			-			-0.42
chi^2	10.67**	10.67	0.33	8.38	-	-	7.28*	7.28	0.04
-2 Log Likelihood	34.37	34.37	34.04	0.00	-	-	26.34	26.34	26.30

One-Tailed Test:

p < .05

p < .01

p < .001

Table 5.7.2
Test of Hypotheses 1a and 1b
Logistic Regression
Leader/Follower Dichotomy Entering Cycle 2

DV= Case 2 LF	**Leader & Multi-Cycled Firm Models (n=5)**			**Follower 1st Entry Models (n=38)**			**Follower & Multi-Cycled Firm Models (n=27)**		
	1	2	3	1	2	3	1	2	3
Intercept	-	-	-	1.43	1.43	1.43	1.23	1.23	1.23
New Entrant?	-	-	-	-	-	-	-	-	-
Pop Density	-	-	-	-	-	-	-	-	-
Entry Size	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00
Price Premium Firm	-	-	-	-1.09	-1.09	-1.09	-0.32	-0.32	-0.32
Cycle Comp History		-	-		-	-		-	-
Case 1 LF			-			-			-
chi^2	6.73	-	-	3.32	3.32	3.32	0.92	0.92	0.92
-2 Log Likelihood	-	-	-	32.99	32.99	32.99	24.96	24.96	24.96

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

Table 5.8.1
Test of Hypotheses 1a and 1b
Logistic Regression
Leader/Follower Dichotomy Entering Cycle 3

DV= Case 2 LF	**Full Models (n=177)**			**Leader 1st Entry Models (n=15)**			**Multi-Cycled Firm Models (n=142)**		
	1	2	3	1	2	3	1	2	3
Intercept	-1.50	-1.50	-1.48	7.62	7.62	21.62	-3.06*	-3.06	-3.23*
New Entrant?	1.44**	1.44	1.42**	0.41	0.41	-28.12	1.8**	1.80	1.71**
Pop Density	0.02**	0.02	0.02*	-0.04	-0.04	-0.12	0.02**	0.02	0.02**
Entry Size	0.00	0.00	0.00*	0.00	0.00	0.00	0.00	0.00	0.00***
Price Premium Firm	-0.83**	-0.83	-1.32***	-0.19	-0.19	-6.84	-0.56*	-0.56	-2.3***
Cycle Comp History		-	-		-	-		-	-
Case 1 LF			2.37*			35.13			8.51***
chi^2	35.56***	35.56	4.13*	6.42	6.42	8.83	31.00***	31.00	13.56***
-2 Log Likelihood	108.59	108.59	104.47	13.77	13.77	4.94	84.44	84.44	70.88

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

Table 5.8.2
Test of Hypotheses 1a and 1b
Logistic Regression
Leader/Follower Dichotomy Entering Cycle 3

DV= Case 2 LF	**Leader & Multi-Cycled Firm Models (n=11)**			**Follower 1st Entry Models (n=162)**			**Follower & Multi-Cycled Firm Models (n=131)**		
	1	2	3	1	2	3	1	2	3
Intercept	-49.35	-49.35	-	-2.12	-2.12	-2.53	-3.04*	-3.04	-3.61*
New Entrant?	21.08	21.08	-	1.65**	1.65	2.13***	1.56*	1.56	1.89**
Pop Density	0.29	0.29	-	0.02**	0.02	0.02*	0.02**	0.02	0.02*
Entry Size	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00
Price Premium Firm	0.30	0.30	-	-1.30**	-1.30	-2.19***	-1.28*	-1.28	-2.78***
Cycle Comp History		-	-		-	-		-	-
Case 1 LF			-			6.87**			8.84**
chi^2	10.34*	10.34	4.09	30.36***	30.36	9.84***	24.15***	24.15	11.63***
-2 Log Likelihood	4.09	4.09	0.00	86.76	86.76	76.92	73.09	73.09	61.46

One-Tailed Test:

p < .05

p < .01

p < .001

Table 5.9.1
Test of Hypotheses 1a and 1b
Logistic Regression
Leader/Follower Dichotomy Entering Cycle 4

DV= Case 2 LF	Full Models (n=161)			Leader 1st Entry Models (n=11)			Multi-Cycled Firm Models (n=152)		
	1	2	3	1	2	3	1	2	3
Intercept	-1.17	-1.30	-1.28	0.78	325.99	314.94	-61.50	-61.60	-61.54
New Entrant?	-0.26	-0.20	-0.20	-1.37	-205.26	-209.80	-0.37	-0.32	-0.32
Pop Density	0.01	0.01	0.01	-	-	-	0.24	0.24	0.24
Entry Size	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Price Premium Firm	-0.52	-0.54	-0.42	0.08	34.26	31.15	-0.52	-0.53	-0.42
Cycle Comp History		0.06	0.06		-144.12	-139.40		0.04	0.05
Case 1 LF			-0.51			15.01			-0.47
chi^2	2.84	0.00	0.31	2.64	7.79	0.00	6.18	0.00	0.27
-2 Log Likelihood	129.22	129.22	128.91	7.79	0.00	0.00	123.02	123.01	122.75

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

Table 5.9.2
Test of Hypotheses 1a and 1b
Logistic Regression
Leader/Follower Dichotomy Entering Cycle 4

DV= Case 2 LF	Leader & Multi-Cycled Firm Models (n=11)			Follower 1st Entry Models (n=150)			Follower & Multi-Cycled Firm Models (n=141)		
	1	2	3	1	2	3	1	2	3
Intercept	0.78	325.99	314.94	-1.54	-2.40	-2.29	-62.13	-63.02	-62.81
New Entrant?	-1.37	-205.26	-209.80	-0.29	0.14	0.13	-0.40	0.03	0.02
Pop Density	-	-	-	0.01	0.01	0.01	0.24	0.24	0.24
Entry Size	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Price Premium Firm	0.08	34.26	31.15	-1.11	-1.19	-0.98	-1.13	-1.21	-1.00
Cycle Comp History		-144.12	-139.40		0.38	0.41		0.37	0.40
Case 1 LF			15.01			-0.72			-0.72
chi^2	2.64	7.79	0.00	2.77	0.18	0.41	6.11	0.17	0.41
-2 Log Likelihood	7.79	0.00	0.00	118.72	118.54	118.13	112.58	112.40	111.99

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

Table 5.10.1
Test of Hypotheses 1a and 1b
Logistic Regression
Leader/Follower Dichotomy Entering Cycle 5

DV= Case 2 LF	**Full Models (n=278)**			**Leader 1st Entry Models (n=16)**			**Multi-Cycled Firm Models (n=210)**		
	1	2	3	1	2	3	1	2	3
Intercept	2.40**	3.10	3.56*	0.90	27.72	27.70	3.43	5.15	6.05**
New Entrant?	0.30	0.01	-0.18	0.17	-10.72	-19.75	0.92	0.35	0.03
Pop Density	0.00	0.00	0.00	0.00	-0.02	-0.02	-0.01	-0.01	-0.01*
Entry Size	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Price Premium Firm	-0.35*	-0.34	-0.25	-0.38	-0.72	-0.72	0.06	0.12	0.40
Cycle Comp History		-0.21	-0.27		-8.11	-8.10		-0.44	-0.55
Case 1 LF			-0.92*			9.04			-1.36**
chi^2	8.32*	0.33	3.01*	7.68	2.55	0.00	2.83	1.31	5.53**
-2 Log Likelihood	202.14	201.81	198.80	7.77	5.22	5.22	154.44	153.14	147.61

One-Tailed Test:

p < .05

p < .01

p < .001

Table 5.10.2
Test of Hypotheses 1a and 1b
Logistic Regression
Leader/Follower Dichotomy Entering Cycle 5

DV= Case 2 LF	**Leader & Multi-Cycled Firm Models (n=11)**			**Follower 1st Entry Models (n=262)**			**Follower & Multi-Cycled Firm Models (n=199)**		
	1	2	3	1	2	3	1	2	3
Intercept	-35.28	-12.44	-24.20	2.47	3.04	3.56^{*}	3.76	5.32	6.12^{**}
New Entrant?	-	-	-	0.30	0.08	-0.20	0.95	0.44	0.13
Pop Density	0.20	0.15	0.18	0.00	0.00	0.00	-0.01	-0.01	-0.01^{*}
Entry Size	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Price Premium Firm	1.18	1.12	1.14	-0.24	-0.22	-0.05	0.02	0.09	0.40
Cycle Comp History		-4.41	-2.56		-0.17	-0.24		-0.40	-0.50
Case 1 LF			15.94			-1.12^{*}			-1.38^{**}
chi^2	2.50	0.26	0.01	1.51	0.21	3.88^{*}	3.26	1.03	5.37^{*}
-2 Log Likelihood	4.20	3.94	3.94	192.98	192.77	188.89	147.18	146.16	140.79

One-Tailed Test:

p < .05

p < .01

p < .001

Tables 5.11.1 through 5.15.2 present the output of the regression analysis testing of Hypothesis 1 using the ranking method of timing. Tables 5.16.1 through 5.20.2 present the results from using the Z-Score timing definition, Tables 5.21.1 through 5.25.2 present the months behind the cycle pioneer consistency definition, and Tables 5.26.1 through 5.30.2 present the regression results for the standardized months behind the cycle pioneer measure. Table 5.31.1 and 5.31.2 offer a view of the results of testing our independent variable (Case 1 timing effort) against our dependent variable (Case 2 timing effort).

Testing of the remainder of the timing definitions follow the same procedure as the testing of our dichotomous variable except that, due to the nature of the variable we can utilize regular regression instead of logistical regression. We proceed with the regression analysis with the same control variables, the same moderating variables (leader first entry, follower first entry, multi-cycled firm, and leader/follower interactions with multi-cycled firms). We again use a hierarchical method of entering our controls first and our independent variable on the final step. Our test for significance is a one-tailed p value of < 0.05. VIF statistic showed no measure of 5.0 or greater, indicating that multi-collinearity of our independent and control variables are within accepted limits.

As expected, the results of the control variables used in the regression tests were very similar to the results we received in the logistical regression. The major differences between the logistical regression results and the results we received in the multiple regression were those of our independent variable. As with the logistical analysis, major differences are found between the full model and the results found when isolating cycles. Therefore, we will concentrate on the results found on a per cycle basis.

We do not find any significance between cycle 1 industry entry timing and cycle 2 entry timing for leaders. Therefore, in this case we cannot state that leaders will again be leaders. However, we do find a significant relationship among the followers. Specifically, it appears that followers in cycle 1 are much more likely to be followers in cycle 2. This is understandable when one considers that in cycle 2 the industry had not been unified by the IBM product architecture. As a result, firms may have been more risk adverse- waiting on a dominant structure to be established.

Cycle 3 represents a period when the IBM dominant design took hold in the PC industry. As a result, many established power relationships in the industry were overturned. Our regression results demonstrate this, and we find significant results for previous leader timing influences. Specifically, we find a negative relationship during this period and that leaders in previous cycle were less likely to be leaders in this cycle. This may be an indication that the IBM design platform was more destructive of previous leader knowledge structures than previously thought. While leaders apparently had trouble adjusting to cycle 3, followers did not. The regression results found very strong support for hypotheses 1b, that followers will be followers when faced with incremental technological changes, during not just cycle 3, but cycles 4 and 5 as well. Further, the interaction between follower firms and multiple cycles were found to be statistically significant indicating that follower firms are more likely to enter multiple cycles.

Therefore, while no conclusive evidence was found to support hypothesis 1a, we do find strong support for Hypothesis 1b. We can therefore conclude that followers do tend to be followers when faced with incremental changes. But, can leaders be leaders? We cannot state conclusively one way or anther with the testing performed to this point. One would imagine that continuous early entry, and thus leadership status is a more difficult proposition than to wait and see which technologies are chosen by the market and then entering once a cycle is supported. We do not have data indicating how many of the leaders attempted

Table 5.32.1 provides more detail into the firms that achieved leadership status over multiple cycles. While only exploratory, this qualitative review of the leaders indicate that very few, only four firms, were able to achieve leadership status three times, and only 24 firms in the PC industry were able to do it twice. The only firms that were able to achieve leadership status on every one of its cycle entries were not shipping by 1991. This may suggest that intense focus on but one entry style may be unhealthy for a firm's long term survivability. We will examine this further in Hypotheses 3a through 3d. The data also suggest, as we might expect, that leader firms are more likely to charge a premium price for their products, with all of the firms that achieved "3-peat" status of leadership employing above average price policies. These firms are also very likely to be included as some of the larger shippers of products in the industry, with all surviving "3-peaters" among the top 25 in the industry in dollar shipments. Finally, 13 of the firms that achieved repeat status as a leader were to some degree diversified. Our resulting picture of the repeat leader firm is a larger, more diversified firm. This seemingly reinforces Teece's (1987) notion that the innovator is not always the one the ends up being successful, as more important are the complementary assets possessed by the firm.

Table 5.11.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Ranking for Cycles 1-5

DV= Case 2 Ranking	Full Models (n=661)			Leader 1st Entry Models (n=49)			Multi-Cycled Firm Models (n=536)		
	1	2	3	1	2	3	1	2	3
Constant	160.52***	150.01	149.12***	92.54	76.08	73.68	185.64***	177.60	177.17***
New Entrant?#	-0.03	-0.11	-0.07	-0.16	-0.32	-0.38	0.02	-0.03	-0.00
Pop Density#	-0.07*	-0.06	-0.20***	0.18	0.19	0.18	-0.17***	0.17	-0.28***
Entry Size#	-0.12**	-0.13	-0.10**	-0.23	-0.23	-0.21	-0.15***	-0.15	-0.12**
Price Premium Firm#	-0.19***	-0.19	-0.13***	-0.30	-0.30	-0.29	-0.18***	-0.18	-0.13**
Cycle Comp History#		.08	-0.11		0.18	0.21		0.06	0.09
Case 1 Ranking#			0.23***			0.06			0.20***
ΔF	9.60***	1.13	22.24***	1.58	0.43	0.09	10.00***	0.61	13.61***
ΔR^2	0.06	0.00	0.03	0.13	0.01	0.00	0.07	0.00	0.02
SE of Estimate	84.91	84.90	83.56	75.37	75.86	76.68	83.65	83.68	82.71

One-Tailed Test:

p < .05

#= Standardized Coefficient

p < .01

p < .001

Table 5.11.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Ranking for Cycles 1-5

DV= Case 2 Ranking	Leader & Multi-Cycled Firm Models (n=38)			Follower 1st Entry Models (n=612)			Follower & Multi-Cycled Firm Models (n=498)		
	1	2	3	1	2	3	1	2	3
Constant	99.47	83.50	76.86	166.74^{***}	153.59	153.47^{***}	191.35^{***}	181.93	183.15^{***}
New Entrant?#	-0.25	-0.41	-0.53	0.00	-0.08	-0.04	0.05	-0.01	0.03
Pop Density#	0.20	0.20	0.18	-0.10^{*}	-0.09	-0.22^{***}	-0.19^{***}	-0.18	-0.30^{***}
Entry Size#	-0.26	-0.25	-0.22	-0.11^{**}	-0.12	-0.08^{*}	-0.13^{**}	-0.13	-0.09^{*}
Price Premium Firm#	-0.03	-0.04	-0.00	-0.21^{***}	-0.21	-0.17^{***}	-0.19^{***}	-0.20	-0.15^{***}
Cycle Comp History#		0.19	0.25		0.10	-0.12		0.07	0.09
Case 1 Ranking#			0.14			0.23^{***}			0.20^{***}
Δ F	1.22	0.42	0.35	10.53^{***}	1.54	18.68^{***}	11.12^{***}	0.71	12.02^{***}
ΔR^2	0.13	0.01	0.01	0.07	0.00	0.03	0.08	0.00	0.02
SE of Estimate	73.25	73.90	74.67	84.60	84.56	83.36	83.54	83.56	82.64

One-Tailed Test:

$p < .05$ #= Standardized Coefficient

$p < .01$

$p < .001$

Table 5.12.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Ranking for Cycle 2

DV= Case 2 Ranking	**Full Models (n=45)**			**Leader 1st Entry Models (n=7)**			**Multi-Cycled Firm Models (n=32)**		
	1	2	3	1	2	3	1	2	3
Constant	73.17^{***}	-	57.92	66.02	-	87.05	76.47^{***}	-	58.85
New Entrant?#	-	-	-	-	-	-	-	-	-
Pop Density#	-	-	-	-	-	-	-	-	-
Entry Size#	0.05	-	0.12	0.16	-	0.31	0.03	-	0.11
Price Premium Firm#	$-.34^{*}$	-	-0.28	-0.50	-	-0.63	-0.41^{*}	-	-0.33
Cycle Comp History#		-	-		-	-		-	-
Case 1 Ranking#		-	0.16			-0.31			0.17
Δ F	3.13^{*}	-	0.90	1.09	-	0.20	3.02^{*}	-	0.65
ΔR^2	0.13	-	0.02	0.35	-	0.04	0.17	-	0.02
SE of Estimate	49.48	-	49.54	46.09	-	51.51	52.56	-	52.87

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.12.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Ranking for Cycle 2

DV= Case 2 Ranking	Leader & Multi-Cycled Firm Models (n=5)			Follower 1st Entry Models (n=38)			Follower & Multi-Cycled Firm Models (n=27)		
	1	2	3	1	2	3	1	2	3
Constant	64.71	-	78.84	67.02^{***}	-	28.73	68.66^{***}	-	31.13
New Entrant?#	-	-	-	-	-	-	-	-	-
Pop Density#	-	-	-	-	-	-	-	-	-
Entry Size#	0.17	-	0.75	0.35^{*}	-	0.45^{**}	0.37^{*}	-	0.46
Price Premium Firm#	-0.85^{*}	-	-0.79	-0.24	-	-0.12	-0.19	-	-0.10
Cycle Comp History#		-	-		-	-		-	-
Case 1 Ranking#			-0.59			0.28^{*}			0.26
Δ F	13.63^{*}	-	2.93	5.23^{**}	-	3.00^{*}	3.46^{*}	-	1.77
ΔR^2	0.93	-	0.05	0.23	-	0.06	0.22	-	0.06
SE of Estimate	15.49	-	11.05	47.87	-	46.55	53.07	-	52.24

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.13.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Ranking for Cycle 3

DV= Case 2 Ranking	Full Models (n=177)			Leader 1st Entry Models (n=15)			Multi-Cycled Firm Models (n=142)		
	1	2	3	1	2	3	1	2	3
Constant	25.60	-	-7.01	45.33	-	152.50	10.65	-	-23.98
New Entrant?#	-0.24^{***}	-	-0.18^{**}	-0.35	-	0.55	-0.31^{***}	-	-0.23^{**}
Pop Density#	0.31^{***}	-	0.24^{***}	0.27	-	0.10	0.28^{***}	-	0.23^{***}
Entry Size#	-0.12^{*}	-	-0.05	-0.26	-	-0.81	-0.12	-	-0.04
Price Premium Firm#	-0.28^{***}	-	-0.12^{*}	-0.15	-	-0.73	-0.21^{**}	-	-0.08
Cycle Comp History#		-	-		-	-		-	-
Case 1 Ranking#			0.41^{***}			-0.91			$.38^{***}$
ΔF	17.96^{***}	-	33.86^{***}	1.13	-	1.46	13.55^{***}	-	23.18^{***}
ΔR^2	0.30	-	0.12	0.31	-	0.10	0.28	-	0.10
SE of Estimate	75.80	-	69.46	78.30	-	76.54	78.08	-	72.43

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.13.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Ranking for Cycle 3

DV= Case 2 Ranking	Leader & Multi-Cycled Firm Models (n=11)			Follower 1st Entry Models (n=162)			Follower & Multi-Cycled Firm Models (n=131)		
	1	2	3	1	2	3	1	2	3
Constant	18.32	-	-215.03	21.15	-	-16.44	7.04	-	-38.18
New Entrant?#	-0.79^{**}	-	-2.20	-0.21^{**}	-	-0.13^{*}	-0.23^{**}	-	-0.14^{*}
Pop Density#	0.39	-	0.83	0.31^{***}	-	0.23^{***}	0.27^{***}	-	0.21^{**}
Entry Size#	-0.20	-	0.73	-0.05	-	0.03	-0.06	-	0.03
Price Premium Firm#	0.14	-	1.03	-0.3^{***}	-	-0.15^{*}	-0.29^{***}	-	-0.14^{*}
Cycle Comp History#		-	-		-	-		-	-
Case 1 Ranking#			1.28			$.43^{***}$			$.43^{***}$
Δ F	4.78^{*}	-	2.51	15.18^{***}	-	35.05^{***}	11.42^{***}	-	26.69^{***}
ΔR^2	0.76	-	0.08	0.28	-	0.13	0.27	-	0.13
SE of Estimate	53.60	-	47.90	75.74	-	68.66	78.70	-	71.73

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.14.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Ranking for Cycle 4

DV= Case 2 Ranking	Full Models (n=161)			Leader 1st Entry Models (n=11)			Multi-Cycled Firm Models (n=152)		
	1	2	3	1	2	3	1	2	3
Constant	205.36	212.28	209.19^{**}	113.87	212.65	278.07	-121.64	-114.04	-116.21
New Entrant?$^{\#}$	-0.06	0.00	0.06	-0.24	0.92	1.82	-0.02	0.05	0.08
Pop Density$^{\#}$	-0.09	-0.09	-0.14^{*}	-	-	-	0.12	0.12	0.09
Entry Size$^{\#}$	-0.12	-0.11	-0.03	-0.16	0.26	0.22	-0.12	-0.11	-0.04
Price Premium Firm$^{\#}$	0.02	0.03	0.15^{*}	0.16	0.70	0.74	0.02	0.03	0.14
Cycle Comp History$^{\#}$		-0.08	-0.02		-1.48	-2.23		-0.08	-0.02
Case 1 Ranking$^{\#}$			$.38^{***}$			-0.52			0.35^{***}
ΔF	1.24	0.14	18.26^{***}	0.35	2.30	0.36	1.10	0.15	14.88^{***}
ΔR^2	0.03	0.00	0.10	0.13	0.24	0.04	0.03	0.00	0.09
SE of Estimate	55.35	55.51	52.65	73.83	67.81	71.77	54.18	54.34	51.92

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.14.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Ranking for Cycle 4

DV= Case 2 Ranking	Leader & Multi-Cycled Firm Models (n=11)			Follower 1st Entry Models (n=150)			Follower & Multi-Cycled Firm Models (n=141)		
	1	2	3	1	2	3	1	2	3
Constant	113.87	212.65	278.07	202.05	193.56	141.69*	-129.11	-139.00	-128.81
New Entrant?#	-0.24	0.92	1.82	-0.01	-0.09	0.00	0.03	-0.05	0.02
Pop Density#	-	-	-	-0.10	-0.10	-0.15	0.13	0.13	0.09
Entry Size#	-0.16	0.26	0.22	-0.17	-0.18	-0.05	-0.17	-0.18	-0.06
Price Premium Firm#	0.16	0.70	0.74	-0.02	-0.06	0.08	-0.04	-0.05	0.05
Cycle Comp History#		-1.48	-2.23		0.09	0.11		0.10	0.12
Case 1 Ranking#			-0.52			.41***			.38***
ΔF	0.35	2.30	0.36	1.64	0.19	18.41***	1.58	0.22	14.98***
ΔR^2	0.13	0.24	0.04	0.04	0.00	0.11	0.04	0.00	0.10
SE of Estimate	73.83	67.81	71.77	54.43	54.58	51.56	53.05	53.21	50.65

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.15.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Ranking for Cycle 5

DV= Case 2 Ranking	Full Models (n=278)			Leader 1st Entry Models (n=16)			Multi-Cycled Firm Models (n=210)		
	1	2	3	1	2	3	1	2	3
Constant	300.29***	336.11***	355.42***	237.03	253.27	273.84	312.97***	359.63***	388.00***
New Entrant?#	-0.15*	-0.02	0.05	-0.18	-0.12	-0.31	-0.11*	-0.03	-0.01
Pop Density#	-0.26***	-0.29***	-0.49***	-0.15	-0.17	-0.23	-0.25***	-0.30***	-0.49***
Entry Size#	-0.08	-0.07	-0.01	-0.18	-0.18	-0.09	-0.09	-0.07	-0.02
Price Premium Firm#	-0.16**	-0.15**	-0.05	-0.40	-0.39	-0.39	-0.11	-0.09	-0.01
Cycle Comp History#		-0.18*	-0.16*		-0.08	-0.03		-0.16*	-0.15*
Case 1 Ranking#			0.43***			0.19			0.37***
ΔF	8.14***	3.26*	39.26***	0.75	0.03	0.18	5.16***	3.72*	23.31***
ΔR^2	0.11	0.01	0.11	0.21	0.00	0.02	0.09	0.02	0.09
SE of Estimate	86.93	86.57	81.06	92.65	97.05	101.30	85.62	85.05	80.75

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.15.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Ranking for Cycle 5

DV= Case 2 Ranking	Leader & Multi-Cycled Firm Models (n=11)			Follower 1st Entry Models (n=262)			Follower & Multi-Cycled Firm Models (n=199)		
	1	2	3	1	2	3	1	2	3
Constant	-29.00	179.06	-228.79	306.77***	334.82	353.59***	331.86***	370.03	400.81***
New Entrant?#	-	-	-	-0.14*	-0.03	0.07	-0.11*	-0.04	-0.02
Pop Density#	0.41	0.57	0.84	-0.27***	-0.30	-0.51***	-0.28***	-0.32	-0.51***
Entry Size#	-0.49	-0.54	-0.81	-0.11*	-0.10	-0.05	-0.14*	-0.12	-0.08
Price Premium Firm#	0.65	0.72	0.85	-0.14**	-0.13	-0.06	-0.14*	-0.12	-0.03
Cycle Comp History#		0.29	0.28		-0.14	-0.14		-0.14	-0.14*
Case 1 Ranking#			-0.39			0.45***			0.37***
ΔF	2.57	0.95	1.17	8.04***	1.88	38.95***	6.65***	2.50	21.19***
ΔR^2	0.52	0.07	0.08	0.11	0.01	0.12	0.12	0.01	0.09
SE of Estimate	63.45	63.67	62.78	86.62	86.47	80.70	84.75	84.42	80.33

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.16.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Z Score for Cycles 1-5

DV= Case 2 Z Score	Full Models (n=661)			Leader 1st Entry Models (n=49)			Multi-Cycled Firm Models (n=539)		
	1	2	3	1	2	3	1	2	3
Constant	-0.23*	-0.26	-0.25*	-0.52	-0.45	-0.51	-0.11	-0.14	-0.12
New Entrant?#	-0.05	-0.07	-0.00	-0.13	-0.08	-0.05	-0.02	-0.04	0.02
Pop Density#	0.05	0.05	0.01	0.11	0.10	0.10	-0.00	-0.03	-0.03
Entry Size#	-0.08*	-0.08	-0.02	-0.10	-0.10	-0.11	-0.09*	-0.09	-0.02
Price Premium Firm#	-0.26***	-0.26	-0.15***	-0.40	-0.40	-0.40	-0.22***	-0.22	-0.11*
Cycle Comp History#		-0.03	0.03		0.05	0.05		0.02	0.02
Case 1 Z Score#			0.31***			-0.04			0.29***
ΔF	13.38***	0.12	57.06***	1.77	0.03	0.03	7.86***	0.06	39.51***
ΔR^2	0.08	0.00	0.07	0.14	0.00	0.00	0.06	0.00	0.07
SE of Estimate	0.89	0.89	0.85	1.15	1.16	1.18	0.87	0.88	0.84

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.16.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Z Score for Cycles 1-5

DV= Case 2 Z Score	Leader & Multi-Cycled Firm Models (n=38)			Follower 1st Entry Models (n=612)			Follower & Multi-Cycled Firm Models (n=498)		
	1	2	3	1	2	3	1	2	3
Constant	-0.60	-0.54	-0.50	-0.21^{*}	-0.29	-0.36^{*}	-0.10	-0.15	-0.18
New Entrant?#	-0.23	-0.18	-0.20	-0.02	-0.07	0.04	0.00	-0.04	0.07
Pop Density#	0.19	0.19	0.19	0.03	0.04	-0.01	-0.02	-0.01	-0.05
Entry Size#	-0.12	-0.12	-0.11	-0.04	-0.04	0.04	-0.04	-0.04	0.04
Price Premium Firm#	-0.19	-0.19	-0.19	-0.23^{***}	-0.24	-0.13^{**}	-0.22^{***}	-0.22	-0.11^{*}
Cycle Comp History#		-0.05	-0.05		0.06	0.06		0.04	0.04
Case 1 Z Score#			0.02			0.38^{***}			0.36^{***}
ΔF	0.85	0.03	0.01	9.53^{***}	0.49	76.73^{***}	6.41^{***}	0.24	52.92^{***}
ΔR^2	0.09	0.00	0.00	0.06	0.00	0.11	0.05	0.00	0.09
SE of Estimate	1.08	1.09	1.12	0.86	0.86	0.81	0.86	0.86	0.82

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.17.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Z Score for Cycle 2

DV= Case 2 Z Score	**Full Models (n=45)**			**Leader 1st Entry Models (n=7)**			**Multi-Cycled Firm Models (n=32)**		
	1	2	3	1	2	3	1	2	3
Constant	-0.48***	-	-0.50	-0.43	-	-0.35	-0.40**	-	-0.40
New Entrant?#	-	-	-	-	-	-	-	-	-
Pop Density#	-	-	-	-	-	-	-	-	-
Entry Size#	0.02	-	0.08	0.00	-	-0.01	0.02	-	0.09
Price Premium Firm#	-0.47***	-	-0.40	-.82*	-	-0.81	-0.50**	-	-0.40
Cycle Comp History#		-	-		-	-		-	-
Case 1 Z Score#			0.15			0.02			0.18
Δ F	6.14***	-	0.82	4.06*	-	0.00	4.95**	-	0.84
ΔR^2	0.23	-	0.02	0.67	-	0.00	0.26	-	0.02
SE of Estimate	0.89	-	0.90	0.64	-	0.74	0.82	-	0.83

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.17.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Z Score for Cycle 2

DV= Case 2 Z Score	Leader & Multi-Cycled Firm Models (n=5)			Follower 1st Entry Models (n=38)			Follower & Multi-Cycled Firm Models (n=27)		
	1	2	3	1	2	3	1	2	3
Constant	-0.42	-	-2.05	-0.61***	-	-0.73***	-0.50**	-	-0.59**
New Entrant?#	-	-	-	-	-	-	-	-	-
Pop Density#	-	-	-	-	-	-	-	-	-
Entry Size#	-0.04	-	0.29	0.26*	-	0.36*	0.40*	-	0.51**
Price Premium Firm#	-1.01*	-	-1.01	-0.37**	-	-0.24	-0.17	-	-0.02
Cycle Comp History#		-	-		-	-		-	-
Case 1 Z Score#			-0.37			0.30*			0.34*
Δ F	21.62*	-	1.13	6.30**	-	3.45*	3.52*	-	3.11*
ΔR^2	0.96	-	0.02	0.27	-	0.07	0.23	-	0.09
SE of Estimate	0.29	-	0.28	0.90	-	0.87	0.83	-	0.80

One-Tailed Test:

p < .05

p < .01

p < .001

#= Standardized Coefficient

Table 5.18.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Z Score for Cycle 3

DV= Case 2 Z Score	Full Models (n=177)			Leader 1st Entry Models (n=15)			Multi-Cycled Firm Models (n=142)		
	1	2	3	1	2	3	1	2	3
Constant	-1.44^{***}	-	-1.50^{***}	-0.68	-	-1.31	-1.99^{***}	-	-2.10^{***}
New Entrant?#	-0.22^{***}	-	-0.20^{**}	-0.17	-	0.68	-0.27^{***}	-	-0.25^{***}
Pop Density#	0.32^{***}	-	0.33^{***}	0.09	-	-0.15	0.35^{***}	-	0.37^{***}
Entry Size#	-0.13^{*}	-	-0.08	-0.34	-	-0.75^{*}	-0.11	-	-0.06
Price Premium Firm#	-0.30^{***}	-	-0.19^{**}	-0.21	-	-0.87^{*}	-0.25^{***}	-	-0.15^{*}
Cycle Comp History#		-	-		-	-		-	-
Case 1 Z Score#			0.22^{**}			-1.04^{**}			0.21^{**}
Δ F	19.40***	-	8.26**	0.79	-	8.24^{**}	16.12^{***}	-	6.04^{**}
ΔR^2	0.31	-	0.03	0.24	-	0.36	0.32	-	0.03
SE of Estimate	0.68	-	0.67	0.83	-	0.61	0.70	-	0.69

One-Tailed Test:

p < .05

p < .01

p < .001

#= Standardized Coefficient

Table 5.18.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Z Score for Cycle 3

DV= Case 2 Z Score	Leader & Multi-Cycled Firm Models (n=11)			Follower 1st Entry Models (n=162)			Follower & Multi-Cycled Firm Models (n=131)		
	1	2	3	1	2	3	1	2	3
Constant	-0.85	-	-0.80	-1.53^{***}	-	-1.69^{***}	-2.09^{***}	-	-2.35^{***}
New Entrant?#	-0.69^{*}	-	0.22	-0.19^{**}	-	-0.13^{*}	-0.20^{**}	-	-0.12
Pop Density#	0.25	-	-0.08	0.33^{***}	-	0.35^{***}	0.35^{***}	-	0.38^{***}
Entry Size#	-0.41	-	-0.82^{*}	-0.05	-	-0.01	-0.05	-	0.01
Price Premium Firm#	0.13	-	-0.55	-0.33^{***}	-	-0.20^{**}	-0.34^{***}	-	-0.20^{**}
Cycle Comp History#		-	-		-	-		-	-
Case 1 Z Score#			-0.88^{*}			0.32^{***}			0.34^{***}
ΔF	5.97^{*}	-	4.60^{*}	17.86^{***}	-	17.48^{***}	15.22^{***}	-	15.17^{***}
ΔR^2	0.80	-	0.10	0.31	-	0.07	0.33	-	0.07
SE of Estimate	0.43	-	0.34	0.67	-	0.63	0.70	-	0.67

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.19.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Z Score for Cycle 4

DV= Case 2 Z Score	Full Models (n=161)			Leader 1st Entry Models (n=11)			Multi-Cycled Firm Models (n=152)		
	1	2	3	1	2	3	1	2	3
Constant	1.52	1.59	1.11	0.26	2.27	1.19	-3.57	-3.50	-3.67
New Entrant?#	-0.05	-0.01	0.07	-0.21	0.72	2.05	-0.02	0.02	0.08
Pop Density#	-0.09	-0.09	-0.07	-	-	-	0.11	0.11	0.11
Entry Size#	-0.04	-0.04	0.05	0.01	0.34	0.11	-0.04	-0.04	0.05
Price Premium Firm#	-0.13	-0.12	0.00	-0.22	0.21	0.15	-0.13	-0.13	-0.02
Cycle Comp History#		-0.04	-0.03		-1.18	-2.03		-0.04	-0.03
Case 1 Z Score#			0.36^{***}			-0.89			0.32^{***}
ΔF	1.38	0.05	15.22^{***}	0.24	1.20	0.74	1.18	0.04	11.91^{***}
ΔR^2	0.03	0.00	0.09	0.09	0.15	0.10	0.03	0.00	0.07
SE of Estimate	0.93	0.94	0.90	1.93	1.91	1.95	0.93	0.93	0.90

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.19.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Z Score for Cycle 4

DV= Case 2 Z Score	Leader & Multi-Cycled Firm Models (n=11)			Follower 1st Entry Models (n=150)			Follower & Multi-Cycled Firm Models (n=141)		
	1	2	3	1	2	3	1	2	3
Constant	0.26	2.27	1.19	1.62	1.44	1.00	-3.43	-3.63	-3.60^{*}
New Entrant?#	-0.21	0.72	2.05	-0.03	-0.13	0.02	0.01	-0.10	0.03
Pop Density#	-	-	-	-0.10	-0.10	-0.09	0.12	0.12	0.11
Entry Size#	0.01	0.34	0.11	-0.09	-0.11	0.08	-0.09	-0.10	0.08
Price Premium Firm#	-0.22	0.21	0.15	-0.02	-0.03	0.11	-0.03	-0.05	0.09
Cycle Comp History#		-1.18	-2.03		0.12	0.09		0.13	0.11
Case 1 Z Score#			-0.89			0.51^{***}			0.47^{***}
ΔF	0.24	1.20	0.74	0.91	0.33	26.87^{***}	0.79	0.37	21.92^{***}
ΔR^2	0.09	0.15	0.10	0.02	0.00	0.15	0.02	0.00	0.14
SE of Estimate	1.93	1.91	1.95	0.86	0.86	0.79	0.85	0.85	0.79

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.20.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Z Score for Cycle 5

DV= Case 2 Z Score	**Full Models (n=278)**			**Leader 1st Entry Models (n=16)**			**Multi-Cycled Firm Models (n=210)**		
	1	2	3	1	2	3	1	2	3
Constant	1.42^{***}	1.84^{***}	1.75^{***}	1.66	2.14	2.29	1.57^{***}	2.11^{***}	2.22^{***}
New Entrant?$^{\#}$	-0.16^{**}	-0.01	0.06	-0.12	0.01	-0.08	-0.13^{*}	-0.03	-0.01
Pop Density$^{\#}$	-0.25^{***}	-0.29^{***}	-0.30^{***}	-0.26	-0.30	-0.29	-0.25^{***}	-0.31^{***}	-0.34^{***}
Entry Size$^{\#}$	-0.06	-0.05	-0.01	-0.02	-0.02	0.00	-0.07	-0.05	-0.01
Price Premium Firm$^{\#}$	-0.22^{***}	-0.21^{***}	-0.11^{*}	-0.40	-0.38	-0.41	-0.12^{*}	-0.11	-0.02
Cycle Comp History$^{\#}$		-0.20^{*}	-0.19^{*}		-0.17	-0.17		-0.19^{*}	-0.19^{**}
Case 1 Z Score$^{\#}$			0.36^{***}			0.09			0.38^{***}
Δ F	9.74^{***}	4.14^{*}	39.13^{***}	1.01	0.12	0.03	5.32^{***}	4.96^{*}	35.01^{***}
ΔR^2	0.13	0.01	0.11	0.27	0.01	0.00	0.09	0.02	0.13
SE of Estimate	0.90	0.89	0.84	1.28	1.33	1.40	0.87	0.86	0.80

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.20.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Z Score for Cycle 5

DV= Case 2 Z Score	Leader & Multi-Cycled Firm Models (n=11)			Follower 1st Entry Models (n=262)			Follower & Multi-Cycled Firm Models (n=199)		
	1	2	3	1	2	3	1	2	3
Constant	-1.42	-2.38	-2.72	1.46***	1.81***	1.66***	1.73***	2.19***	2.31***
New Entrant?#	-	-	-	-0.15**	-0.02	0.09	-0.12*	-0.04	-0.01
Pop Density#	0.35	0.49	0.56	-0.27***	-0.30***	-0.30***	-0.27***	-0.32***	-0.35***
Entry Size#	-0.45	-0.49	-0.63	-0.10*	-0.09	-0.04	-0.12*	-0.10	-0.06
Price Premium Firm#	0.71*	0.77	0.88	-0.14*	-0.13*	-0.04	-0.15*	-0.13*	-0.03
Cycle Comp History#		0.24	0.28		-0.17*	-0.17*		-0.16*	-0.18*
Case 1 Z Score#			-0.24			0.40***			0.37***
Δ F	3.14*	0.68	0.54	7.80***	2.82*	44.67***	6.56***	3.50*	31.77***
Δ R^2	0.57	0.04	0.04	0.11	0.01	0.13	0.12	0.02	0.12
SE of Estimate	0.47	0.48	0.50	0.88	0.88	0.81	0.87	0.86	0.80

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.21.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Months from Pioneer for Cycles 1-5

DV= Case 2 Mths from Pioneer	**Full Models (n=661)**			**Leader 1st Entry Models (n=49)**			**Multi-Cycled Firm Models (n=536)**		
	1	2	3	1	2	3	1	2	3
Constant	98.42***	100.03	85.23***	87.23***	89.34	91.50	103.44***	105.51	89.62***
New Entrant? #	-0.15***	-0.10	-0.04	-0.19	-0.12	-0.02	-0.14***	-0.09	-0.01
Pop Density #	-0.24***	-0.24	-0.35***	-0.11	-0.11	-0.07	-0.29***	-0.30	-0.41***
Entry Size #	-0.06*	-0.06	-0.02	-0.10	-0.10	-0.11	-0.08*	-0.08	-0.02
Price Premium Firm #	-0.25***	-0.25	-0.16***	-0.40**	-0.40	-0.42	-0.23***	-0.22	-0.13**
Cycle Comp History #		-0.05	-0.00		-0.08	-0.11		-0.07	-0.01
Case 1 Mths from Pioneer #			0.29***			-0.12			0.30***
Δ F	32.88***	0..53	44.77***	2.82*	0.08	0.28	31.57***	0.82	38.20***
ΔR^2	0.17	0.00	0.05	0.20	0.00	0.01	0.19	0.00	0.05
SE of Estimate	18.99	18.99	18.39	22.13	22.36	22.55	18.62	18.63	18.01

One-Tailed Test:

p < .05

p < .01

p < .001

#= Standardized Coefficient

Table 5.21.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Months from Pioneer for Cycles 1-5

DV= Case 2 Mths from Pioneer	Leader & Multi-Cycled Firm Models (n=38)			Follower 1st Entry Models (n=612)			Follower & Multi-Cycled Firm Models (n=498)		
	1	2	3	1	2	3	1	2	3
Constant	87.37	89.40	93.23	99.07***	100.21	79.45***	104.28***	106.29	83.82***
New Entrant? #	-0.30	-0.23	-0.06	-0.13***	-0.10	0.00	-0.13**	-0.08	0.05
Pop Density #	-0.05	-0.06	-0.01	-0.26***	-0.26	-0.40***	-0.31***	-0.32	-0.46***
Entry Size #	-0.14	-0.14	-0.18	-0.01	-0.01	0.05	-0.01	-0.01	0.06
Price Premium Firm #	-0.27	-0.27	-0.33	-0.24***	-0.24	-0.16***	-0.22***	-0.21	-0.12**
Cycle Comp History #		-0.08	-0.14		-0.04	0.03		-0.06	-0.01
Case 1 Mths from Pioneer #			-0.20			0.35***			0.38***
Δ F	1.70	0.09	0.38	30.85***	0.24	57.01***	30.08***	0.66	53.67***
ΔR^2	0.17	0.00	0.01	0.17	0.00	0.07	0.20	0.00	0.08
SE of Estimate	20.29	20.57	20.77	18.63	18.64	17.84	18.50	18.51	17.59

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.22.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Months from Pioneer for Cycle 2

DV= Case 2 Mths from Pioneer	Full Models (n=45)			Leader 1st Entry Models (n=7)			Multi-Cycled Firm Models (n=32)		
	1	2	3	1	2	3	1	2	3
Constant	84.57***	-	75.16	86.06***	-	85.25	87.14***	-	76.97
New Entrant? #	-	-	-	-	-	-	-	-	-
Pop Density #	-	-	-	-	-	-	-	-	-
Entry Size #	0.02	-	0.08	0.00	-	-0.01	0.02	-	0.09
Price Premium Firm #	-0.47**	-	-0.40	-0.82*	-	-0.81	-0.50**	-	-0.40
Cycle Comp History #		-	-		-	-		-	-
Case 1 Mths from Pioneer #			0.15			0.02			0.18
Δ F	6.14**	-	0.82	4.06*	-	0.00	4.95**	-	0.84
Δ R^2	0.23	-	0.02	0.67	-	0.00	0.26	-	0.02
SE of Estimate	26.76	-	26.82	19.11	-	22.05	24.66	-	24.73

One-Tailed Test:

p < .05

p < .01

p < .001

#= Standardized Coefficient

Table 5.22.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Months from Pioneer for Cycle 2

DV= Case 2 Mths from Pioneer	Leader & Multi-Cycled Firm Models (n=5)			Follower 1st Entry Models (n=38)			Follower & Multi-Cycled Firm Models (n=27)		
	1	2	3	1	2	3	1	2	3
Constant	86.55^{**}	-	90.17	80.84^{***}	-	52.92^{*}	83.92^{***}	-	58.51^{***}
New Entrant? #	-	-	-	-	-	-	-	-	-
Pop Density #	-	-	-	-	-	-	-	-	-
Entry Size #	-0.04	-	0.29	0.26^{*}	-	0.36^{*}	0.39^{*}	-	0.51^{**}
Price Premium Firm #	-1.01^{*}	-	-1.01	-0.37^{**}	-	-0.24	-0.17	-	-0.02
Cycle Comp History #		-	-		-	-		-	-
Case 1 Mths from Pioneer #			-0.37			0.30^{*}			0.34^{*}
Δ F	21.62^{*}	-	1.13	6.30^{**}	-	3.45^{*}	3.52^{*}	-	3.11^{*}
ΔR^2	0.96	-	0.02	0.27	-	0.07	0.23	-	0.09
SE of Estimate	8.71	-	8.45	26.83	-	25.93	24.91	-	23.89

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.23.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Months from Pioneer for Cycle 3

DV= Case 2 Mths from Pioneer	Full Models (n=177)			Leader 1st Entry Models (n=15)			Multi-Cycled Firm Models (n=142)		
	1	2	3	1	2	3	1	2	3
Constant	54.98^{***}	-	44.41^{***}	76.27	-	96.08^{**}	39.61^{***}	-	28.23^{*}
New Entrant? #	-0.22^{**}	-	-0.20^{**}	-0.17	-	0.68	-0.27^{***}	-	-0.25^{***}
Pop Density #	0.32^{***}	-	0.25^{***}	0.09	-	0.22	0.35^{***}	-	0.31^{***}
Entry Size #	-0.13^{*}	-	-0.08	-0.39	-	-0.75^{*}	-0.11	-	-0.06
Price Premium Firm #	-0.30^{***}	-	-0.19^{**}	-0.21	-	-0.87^{*}	-0.25^{***}	-	-0.15^{*}
Cycle Comp History #		-	-		-	-		-	-
Case 1 Mths from Pioneer #			0.24^{**}			-1.14^{**}			0.21^{**}
Δ F	19.40^{***}	-	8.38^{**}	0.79	-	8.28^{**}	16.12^{***}	-	6.05^{**}
ΔR^2	0.31	-	0.03	0.24	-	0.36	0.32	-	0.03
SE of Estimate	18.97	-	18.58	23.11	-	17.58	19.60	-	19.25

One-Tailed Test:

p < .05

p < .01

p < .001

#= Standardized Coefficient

Table 5.23.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Months from Pioneer for Cycle 3

DV= Case 2 Mths from Pioneer	**Leader & Multi-Cycled Firm Models (n=11)**			**Follower 1st Entry Models (n=162)**			**Follower & Multi-Cycled Firm Models (n=131)**		
	1	2	3	1	2	3	1	2	3
Constant	71.33*	-	100.05**	52.51***	-	32.48***	36.72***	-	12.86
New Entrant? #	-0.69*	-	0.22	-0.19**	-	-0.13*	-0.20**	-	-0.12
Pop Density #	0.25	-	0.17	0.33***	-	0.22**	0.35***	-	0.26***
Entry Size #	-0.41	-	-0.82*	-0.05	-	-0.01	-0.05	-	0.01
Price Premium Firm #	0.13	-	-0.55	-0.33***	-	-0.20**	-0.34***	-	-0.20**
Cycle Comp History #		-	-		-	-		-	-
Case 1 Mths from Pioneer #			-0.91*			0.34***			0.35***
Δ F	5.97*	-	4.60*	17.86***	-	17.59***	15.22***	-	15.14***
ΔR^2	0.80	-	0.10	0.31	-	0.07	0.33	-	0.07
SE of Estimate	12.07	-	9.54	18.61	-	17.70	19.58	-	18.56

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.24.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Months from Pioneer for Cycle 4

DV= Case 2 Mths from Pioneer	**Full Models (n=161)**			**Leader 1st Entry Models (n=11)**			**Multi-Cycled Firm Models (n=152)**		
	1	2	3	1	2	3	1	2	3
Constant	93.01	93.99	67.75^{**}	75.04	103.64	169.89	20.41	21.43	1.42
New Entrant? #	-0.05	-0.01	0.07	-0.21	0.71	2.05	-0.02	0.02	0.08
Pop Density #	-0.09	-0.09	-0.06	-	-	-	0.11	0.11	0.11
Entry Size #	-0.04	-0.04	0.05	0.01	0.34	0.11	-0.04	-0.04	0.05
Price Premium Firm #	-0.13	-0.12	0.00	-0.22	0.21	0.15	-0.13	-0.13	-0.02
Cycle Comp History #		-0.04	-0.03		-1.18	-2.03		-0.04	-0.03
Case 1 Mths from Pioneer #			0.36^{***}			-0.89			0.32^{***}
ΔF	1.38	0.05	15.24^{***}	0.24	1.20	0.74	1.18	0.04	11.91^{***}
ΔR^2	0.03	0.00	0.09	0.09	0.15	0.10	0.03	0.00	0.07
SE of Estimate	13.29	13.33	12.76	27.56	27.17	27.78	13.20	13.25	12.78

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.24.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Months from Pioneer for Cycle 4

DV= Case 2 Mths from Pioneer	**Leader & Multi-Cycled Firm Models (n=11)**			**Follower 1st Entry Models (n=150)**			**Follower & Multi-Cycled Firm Models (n=141)**		
	1	2	3	1	2	3	1	2	3
Constant	75.04	103.64	169.89	94.38	91.86	59.00**	22.52	19.59	-4.58
New Entrant? #	-0.21	0.72	2.05	-0.03	-0.13	0.02	0.01	-0.10	0.03
Pop Density #	-	-	-	-0.10	-0.10	-0.07	0.12	0.12	0.12
Entry Size #	0.01	0.34	0.11	-0.09	-0.11	0.08	-0.09	-0.10	0.08
Price Premium Firm #	-0.22	0.21	0.15	-0.02	-0.03	0.11	-0.03	-0.05	0.09
Cycle Comp History #		-1.18	-2.03		0.12	0.09		0.13	0.11
Case 1 Mths from Pioneer #			-0.89			0.51***			0.47***
ΔF	0.24	1.20	74.00	0.91	0.33	26.87***	0.79	0.37	21.92***
ΔR^2	0.09	0.15	0.10	0.02	0.00	0.15	0.02	0.00	0.14
SE of Estimate	27.56	27.17	27.78	12.27	12.30	11.33	12.11	12.14	11.29

One-Tailed Test:

p < .05

p < .01

p < .001

#= Standardized Coefficient

Table 5.25.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Months from Pioneer for Cycle 5

DV= Case 2 Mths from Pioneer	**Full Models (n=278)**			**Leader 1st Entry Models (n=16)**			**Multi-Cycled Firm Models (n=210)**		
	1	2	3	1	2	3	1	2	3
Constant	105.24***	112.97***	104.59***	109.65	118.52	113.35	107.99***	118.08***	108.96***
New Entrant?	-0.16**	-0.01	0.05	-0.12	0.01	-0.22	-0.13*	-0.03	0.01
Pop Density	-0.25***	-0.29***	-0.44***	-0.26	-0.30	-0.32	-0.25***	-0.31***	-0.55***
Entry Size #	-0.06	-0.05	-0.02	-0.02	-0.02	0.02	-0.07	-0.05	0.00
Price Premium Firm #	-0.22***	-0.21***	-0.13*	-0.40	-0.38	-0.43	-0.12*	-0.11	-0.03
Cycle Comp History #		-0.20*	-0.19*		-0.17	-0.15		-0.19*	-0.18*
Case 1 Mths from Pioneer #			0.30***			0.23			0.42***
Δ F	9.74***	4.14*	17.95***	1.01	0.12	0.27	5.32***	4.96*	26.02***
ΔR^2	0.13	0.01	0.05	0.27	0.01	0.02	0.09	0.02	0.10
SE of Estimate	16.67	16.57	16.08	23.68	24.69	25.64	16.09	15.93	15.04

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.25.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Months from Pioneer for Cycle 5

DV= Case 2 Mths from Pioneer	Leader & Multi-Cycled Firm Models (n=11)			Follower 1st Entry Models (n=262)			Follower & Multi-Cycled Firm Models (n=199)		
	1	2	3	1	2	3	1	2	3
Constant	52.62**	34.87	32.24	106.04***	112.52***	102.63***	110.92***	119.46***	110.89***
New Entrant?	-	-	-	-0.15**	-0.02	0.06	-0.12*	-0.04	0.00
Pop Density	0.35	0.49	0.87	-0.27***	-0.30***	-0.46***	-0.27***	-0.32***	-0.56***
Entry Size #	-0.45	-0.49	-0.78	-0.10*	-0.09	-0.06	-0.12*	-0.10	-0.07
Price Premium Firm #	0.71*	0.77	0.91	-0.14*	-0.13*	-0.08	-0.15*	-0.13*	-0.04
Cycle Comp History #		0.24	0.32		-0.17*	-0.17*		-0.16*	-0.17*
Case 1 Mths from Pioneer #			-0.39			0.33***			0.41***
ΔF	3.14*	0.68	0.85	7.80***	2.82*	18.24***	6.56***	3.50*	23.21***
ΔR^2	0.57	0.04	0.06	0.11	0.01	0.06	0.12	0.02	0.09
SE of Estimate	8.70	8.90	9.02	16.36	16.30	15.78	16.09	15.98	15.14

One-Tailed Test:

p < .05

p < .01

p < .001

#= Standardized Coefficient

Table 5.26.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Standard Months from Pioneer for Cycles 1-5

DV= Case 2 Std Mths from Pioneer	**Full Models (n=661)**			**Leader 1st Entry Models (n=49)**			**Multi-Cycled Firm Models (n=536)**		
	1	2	3	1	2	3	1	2	3
Constant	2.46^{***}	2.25^{***}	1.38^{***}	2.20^{***}	2.04	1.94	2.39^{***}	2.15^{***}	1.26^{***}
New Entrant? #	0.03	-0.07	0.01	-0.07	-0.15	-0.24	0.02	-0.10	-0.06
Pop Density #	0.46^{***}	0.47^{***}	0.38^{***}	0.49^{**}	0.49	0.47	0.47^{***}	0.48^{***}	0.44^{***}
Entry Size #	-0.06^{*}	-0.06^{*}	0.04	-0.09	-0.09	-0.04	-0.06^{*}	-0.06^{*}	0.05
Price Premium Firm #	-0.23^{***}	-0.23^{***}	-0.10^{**}	-0.38^{**}	-0.38	-0.35	-0.18^{***}	-0.19^{***}	-0.06
Cycle Comp History #		0.12^{*}	-0.07		0.09	0.02		0.13^{*}	-0.04
Case 1 Mths from Pioneer #			0.43^{***}			0.23			0.40^{***}
Δ F	61.75^{***}	2.99^{*}	156.61^{***}	4.41^{**}	0.13	1.23	49.32^{***}	3.65^{*}	98.28^{***}
ΔR^2	0.27	0.00	0.14	0.29	0.00	0.02	0.27	0.01	0.11
SE of Estimate	1.05	1.04	0.94	1.34	1.35	1.35	1.02	1.01	0.93

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.26.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Standard Months from Pioneer for Cycles 1-5

DV= Case 2 Std Mths from Pioneer	**Leader & Multi-Cycled Firm Models (n=38)**			**Follower 1st Entry Models (n=612)**			**Follower & Multi-Cycled Firm Models (n=498)**		
	1	2	3	1	2	3	1	2	3
Constant	1.92^{**}	1.75	1.42	2.46^{***}	2.21^{***}	1.05^{***}	2.38^{***}	2.11^{***}	0.96^{***}
New Entrant? #	-0.20	-0.29	-0.47	0.06	-0.06	0.05	0.05	-0.08	-0.01
Pop Density #	0.63^{***}	0.64	0.66	0.46^{***}	0.47^{***}	0.36^{***}	0.47^{***}	0.48^{***}	0.42^{***}
Entry Size #	-0.07	-0.07	0.05	-0.01	-0.02	0.13^{***}	-0.01	-0.01	0.13^{***}
Price Premium Firm #	-0.12	-0.12	-0.02	-0.20^{***}	-0.21^{***}	-0.08^{**}	-0.19^{***}	-0.20^{***}	-0.07^{*}
Cycle Comp History #		0.10	-0.03		0.14^{*}	-0.11^{*}		0.15^{*}	-0.08
Case 1 Mths from Pioneer #			0.39			0.49^{***}			0.46^{***}
Δ F	4.54^{**}	0.16	2.44	54.39^{***}	3.79^{*}	205.12^{***}	46.68^{***}	4.27^{*}	125.33^{***}
ΔR^2	0.36	0.00	0.05	0.26	0.01	0.19	0.26	0.01	0.15
SE of Estimate	1.22	1.23	1.21	1.02	1.02	0.88	1.00	1.00	0.89

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.27.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Standard Months from Pioneer for Cycle 2

DV= Case 2 Std Mths from Pioneer	Full Models (n=45)			Leader 1st Entry Models (n=7)			Multi-Cycled Firm Models (n=32)		
	1	2	3	1	2	3	1	2	3
Constant	2.90***	-	2.58	2.95***	-	2.92	2.99***	-	2.64
New Entrant? #	-	-	-	-	-	-	-	-	-
Pop Density #	-	-	-	-	-	-	-	-	-
Entry Size #	0.02	-	0.08	0.00	-	-0.01	0.02	-	0.09
Price Premium Firm #	-0.47***	-	-0.40	-0.82*	-	-0.81	-0.50**	-	-0.40
Cycle Comp History #		-	-		-	-		-	-
Case 1 Mths from Pioneer #			0.15			0.02			0.18
Δ F	6.14**	-	0.82	4.06*	-	0.00	4.95**	-	0.84
ΔR^2	0.23	-	0.02	0.67	-	0.00	0.26	-	0.02
SE of Estimate	0.92	-	0.92	0.65	-	0.76	0.84	-	0.85

One-Tailed Test:

p < .05

p < .01

p < .001

#= Standardized Coefficient

Table 5.27.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Standard Months from Pioneer for Cycle 2

DV= Case 2 Std Mths from Pioneer	Leader & Multi-Cycled Firm Models (n=5)			Follower 1st Entry Models (n=38)			Follower & Multi-Cycled Firm Models (n=27)		
	1	2	3	1	2	3	1	2	3
Constant	2.97**	-	3.09	2.77***	-	1.81***	2.88***	-	2.00***
New Entrant? #	-	-	-	-	-	-	-	-	-
Pop Density #	-	-	-	-	-	-	-	-	-
Entry Size #	-0.04	-	0.29	0.26*	-	0.36*	0.39*	-	0.51**
Price Premium Firm #	-1.01*	-	-1.01	-0.37**	-	-0.24	-0.17	-	-0.02
Cycle Comp History #		-	-		-	-		-	-
Case 1 Mths from Pioneer #			-0.37			0.30*			0.34*
ΔF	21.62*	-	1.13	6.30**	-	3.45*	3.52*	-	3.11*
ΔR^2	0.96	-	0.02	0.27	-	0.07	0.23	-	0.09
SE of Estimate	0.30	-	0.29	0.92	-	0.89	0.85	-	0.82

One-Tailed Test:

p < .05

p < .01

p < .001

#= Standardized Coefficient

Table 5.28.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Standard Months from Pioneer for Cycle 3

DV= Case 2 Std Mths from Pioneer	**Full Models (n=177)**			**Leader 1st Entry Models (n=15)**			**Multi-Cycled Firm Models (n=142)**		
	1	2	3	1	2	3	1	2	3
Constant	2.18^{***}	-	1.80^{***}	3.02	-	96.08^{**}	1.57^{***}	-	1.17^{*}
New Entrant? #	-0.22^{**}	-	-0.20^{**}	-0.17	-	0.68^{*}	-0.27^{***}	-	-0.25^{***}
Pop Density #	0.32^{***}	-	0.25^{***}	0.09	-	0.22	0.35^{***}	-	0.31^{***}
Entry Size #	-0.13^{*}	-	-0.08	-0.39	-	-0.75^{*}	-0.11	-	-0.06
Price Premium Firm #	-0.30^{***}	-	-0.19^{**}	-0.21	-	-0.87^{*}	-0.25^{***}	-	-0.15^{*}
Cycle Comp History #		-	-		-	-		-	-
Case 1 Mths from Pioneer #			0.24^{**}			-1.14^{**}			0.22^{**}
ΔF	19.40^{***}	-	8.60^{**}	0.79	-	8.35^{**}	16.12^{***}	-	6.06^{**}
ΔR^2	0.31	-	0.03	0.24	-	0.36	0.32	-	0.03
SE of Estimate	0.75	-	0.73	0.91	-	0.69	0.78	-	0.76

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.28.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Standard Months from Pioneer for Cycle 3

DV= Case 2 Std Mths from Pioneer	**Leader & Multi-Cycled Firm Models (n=11)**			**Follower 1st Entry Models (n=162)**			**Follower & Multi-Cycled Firm Models (n=131)**		
	1	2	3	1	2	3	1	2	3
Constant	2.82^{*}	-	3.91^{**}	2.08^{***}	-	1.37^{***}	1.45^{***}	-	0.62
New Entrant? #	-0.69^{*}	-	0.22	-0.19^{**}	-	-0.13^{*}	-0.20^{**}	-	-0.12
Pop Density #	0.25	-	0.17	0.33^{***}	-	0.22^{**}	0.35^{***}	-	0.26^{***}
Entry Size #	-0.41	-	-0.82^{*}	-0.05	-	-0.01	-0.05	-	0.01
Price Premium Firm #	0.13	-	-0.55	-0.33^{***}	-	-0.20^{**}	-0.34^{***}	-	-0.20^{**}
Cycle Comp History #		-	-		-	-		-	-
Case 1 Mths from Pioneer #			-0.92^{*}			0.35^{***}			0.35^{***}
ΔF	5.97^{*}	-	4.60^{*}	17.86^{***}	-	17.80^{***}	15.22^{***}	-	15.09^{***}
ΔR^2	0.80	-	0.10	0.31	-	0.07	0.33	-	0.07
SE of Estimate	0.48	-	0.38	0.74	-	0.70	0.77	-	0.73

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.29.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Standard Months from Pioneer for Cycle 4

DV= Case 2 Std Mths from Pioneer	Full Models (n=161)			Leader 1st Entry Models (n=11)			Multi-Cycled Firm Models (n=152)		
	1	2	3	1	2	3	1	2	3
Constant	7.11	7.19	5.82***	5.74	7.92	12.99	1.56	1.64	0.66
New Entrant? #	-0.05	-0.01	0.07	-0.21	0.72	2.05	-0.02	0.02	0.08
Pop Density #	-0.09	-0.09	-0.09	-	-	-	0.11	0.11	0.10
Entry Size #	-0.04	-0.04	0.05	0.01	0.34	0.11	-0.04	-0.04	0.05
Price Premium Firm #	-0.13	-0.12	0.00	-0.22	0.21	0.15	-0.13	-0.13	-0.02
Cycle Comp History #		-0.04	-0.03		-1.18	-2.03		-0.04	-0.03
Case 1 Mths from Pioneer #			0.36***			-0.89			0.32***
ΔF	1.38	0.05	15.20***	0.24	1.20	0.74	1.18	0.04	11.91***
ΔR^2	0.03	0.00	0.09	0.09	0.15	0.10	0.03	0.00	0.07
SE of Estimate	1.02	1.02	0.98	2.11	2.08	2.12	1.01	1.01	0.98

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.29.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Standard Months from Pioneer for Cycle 4

DV= Case 2 Std Mths from Pioneer	Leader & Multi-Cycled Firm Models (n=11)			Follower 1st Entry Models (n=150)			Follower & Multi-Cycled Firm Models (n=141)		
	1	2	3	1	2	3	1	2	3
Constant	5.74	7.92	12.99	7.22	7.02	5.38***	1.72	1.50	0.42
New Entrant? #	-0.21	0.72	2.05	-0.03	-0.13	0.02	0.01	-0.10	0.03
Pop Density #	-	-	-	-0.10	-0.10	-0.12	0.12	0.12	0.10
Entry Size #	0.01	0.34	0.11	-0.09	-0.11	0.08	-0.09	-0.10	0.08
Price Premium Firm #	-0.22	0.21	0.15	-0.02	-0.03	0.11	-0.03	-0.05	0.09
Cycle Comp History #		-1.18	-2.03		0.12	0.09		0.13	0.11
Case 1 Mths from Pioneer #			-0.89			0.51***			0.47***
Δ F	0.24	1.20	74.00	0.91	0.33	26.87***	0.79	0.37	21.92***
ΔR^2	0.09	0.15	0.10	0.02	0.00	0.15	0.02	0.00	0.14
SE of Estimate	2.11	2.08	2.12	0.94	0.94	0.87	0.93	0.93	0.86

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.30.1
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Standard Months from Pioneer for Cycle 5

DV= Case 2 Std Mths from Pioneer	**Full Models (n=278)**			**Leader 1st Entry Models (n=16)**			**Multi-Cycled Firm Models (n=210)**		
	1	2	3	1	2	3	1	2	3
Constant	6.02^{***}	6.46^{***}	2.60^{***}	6.27	6.78	6.06	6.18^{***}	6.76^{***}	3.18^{***}
New Entrant? #	-0.16^{**}	-0.01	0.05	-0.12	0.01	-0.08	-0.13^{*}	-0.03	-0.02
Pop Density #	-0.25^{***}	-0.29^{***}	0.02	-0.26	-0.30	-0.23	-0.25^{***}	-0.31^{***}	-0.01
Entry Size #	-0.06	-0.05	0.01	-0.02	-0.02	0.00	-0.07	-0.05	0.00
Price Premium Firm #	-0.22^{***}	-0.21^{***}	-0.08	-0.40	-0.38	-0.41	-0.12^{*}	-0.11	0.00
Cycle Comp History #		-0.20^{*}	-0.22^{**}		-0.17	-0.17		-0.19^{*}	-0.20^{**}
Case 1 Mths from Pioneer #			0.55^{***}			0.13			0.49^{***}
Δ F	9.74^{***}	4.14^{*}	74.20^{***}	1.01	0.12	0.03	5.32^{***}	4.96^{*}	36.39^{***}
ΔR^2	0.13	0.01	0.19	0.27	0.01	0.00	0.09	0.02	0.13
SE of Estimate	0.95	0.95	0.84	1.35	1.41	1.49	0.92	0.91	0.84

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.30.2
Test of Hypotheses 1a and 1b
Hierarchical Regression
Consistency of Standard Months from Pioneer for Cycle 5

DV= Case 2 Std Mths from Pioneer	Leader & Multi-Cycled Firm Models (n=11)			Follower 1st Entry Models (n=262)			Follower & Multi-Cycled Firm Models (n=199)		
	1	2	3	1	2	3	1	2	3
Constant	3.01**	2.00	3.33	6.07***	6.44***	2.03***	6.35***	6.84***	3.28***
New Entrant? #	-	-	-	-0.15**	-0.02	0.08	-0.12*	-0.04	-0.03
Pop Density #	0.35	0.49	0.33	-0.27***	-0.30***	0.06	-0.27***	-0.32***	-0.03
Entry Size #	-0.45	-0.49	-0.63	-0.10*	-0.09	-0.03	-0.12*	-0.10	-0.07
Price Premium Firm #	0.71*	0.77	0.88	-0.14*	-0.13*	0.00	-0.15*	-0.13*	0.00
Cycle Comp History #		0.24	0.28		-0.17*	-0.22**		-0.16*	-0.18*
Case 1 Mths from Pioneer #			-0.37			0.61***			0.48***
ΔF	3.14*	0.68	0.54	7.80***	2.82*	87.35***	6.56***	3.50*	33.19***
ΔR^2	0.57	0.04	0.04	0.11	0.01	0.23	0.12	0.02	0.13
SE of Estimate	0.50	0.51	0.53	0.94	0.93	0.81	0.92	0.91	0.85

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.31.1
Test of Hypotheses 1a – 1d
Overview of Consistency Results

	Full Models						Leader 1st Entry Models						Multi-Cycled Firm Models					
Cycle=	All	2	3	4	5	6	All	2	3	4	5	6	All	2	3	4	5	6
L/F Categorical Follower = 1	NS	NS	S	NS	-S	-S	NS	NS	NS	NS	NS	NS	NS	NS	S	NS	-S	-S
Case 1 Ranking	S	NS	S	S	S	NS	NS	NS	NS	NS	NS	NS	S	NS	S	S	S	S
Z Score	S	NS	S	S	S	NS	NS	NS	-S	NS	NS	NS	S	NS	S	S	S	S
Months Behind Pioneer	S	NS	S	S	S	NS	NS	NS	-S	NS	NS	NS	S	NS	S	S	S	S
Standard Months Behind Pioneer	S	NS	S	S	S	S	NS	NS	-S	NS	NS	NS	S	NS	S	S	S	S

Table 5.31.2
Test of Hypotheses 1a – 1d
Overview of Consistency Results (continued)

	Leader & Multi-Cycled Firm Models						Follower 1st Entry Models						Follower & Multi-Cycled Firm Models					
Cycle=	All	2	3	4	5	6	All	2	3	4	5	6	All	2	3	4	5	6
L/F Categorical Follower = 1	NS	NS	NS	NS	NS	NS	NS	NS	S	NS	-S	-S	NS	NS	S	NS	-S	-S
Case 1 Ranking	NS	NS	NS	NS	NS	NS	S	S	S	S	S	NS	S	NS	S	S	S	S
Z Score	NS	NS	-S	NS	NS	NS	S	S	S	S	S	NS	S	NS	S	S	S	NS
Months Behind Pioneer	NS	NS	-S	NS	NS	NS	S	S	S	S	S	NS	S	S	S	S	S	NS
Standard Months Behind Pioneer	NS	NS	-S	NS	NS	NS	S	S	S	S	S	S	S	S	S	S	S	NS

Table 5.32.1
A Closer Look at the Leaders and Their Actions

Firm	# of Leader Cycles	Year Begin	Cycles Competed	Shipped in 1991?[#]	Z Score Price Premium	Top 25 in Cumulative $ Shipments?	Diversification Type[1]
COMPAQ	3	1983	2,3,4,5,6	Yes	0.94	Yes	0
IBM*	3	1975	1,2,3,4,5,6	Yes	1.62	Yes	8
NEC TECHNOLOGIES, INC.	3	1980	1,2,3,4,5,6	Yes	1.06	Yes	9
TEKTRONIX*	3	1975	1,2,3,4	1986	4.34	No	9
AMERICAN RESEARCH CORP.*	2	1982	2,3,4,5	Yes	-0.49	No	0
APPLE*	2	1977	1,3,5,6	Yes	-0.45	Yes	1
COMARK CORPORATION	2	1980	1,3,5	Yes	1.09	No	7
COMPUTREND SYSTEMS, INC.	2	1987	3,4,5	Yes	-0.22	No	0
CORVUS SYSTEMS	2	1982	1,2,3,5	1987	-0.18	No	6
DIGITAL EQUIPMENT CORPORATION	2	1979	1,3,4,5,6	Yes	0.27	Yes	8
ELTECH RESEARCH	2	1984	3,4,5	Yes	-0.26	No	Not known
FIVESTAR COMPUTERS	2	1985	3,4,5,6	1990	-0.78	No	0
FOUNTAIN TECHNOLOGIES, INC.	2	1984	2,3,4,5,6	Yes	-0.23	No	0
GCH SYSTEMS	2	1984	2,3,4,5	Yes	-0.36	No	0
INTERNATIONAL INSTRUMENTATION	2	1984	3,4,5	Yes	-0.23	No	0
J C SYSTEMS	2	1983	1,3,5	Yes	0.09	No	9
ORCATECH*	2	1981	3,5	1986	8.5	No	13
PC CRAFT	2	1985	2,3,4,5	1989	-0.19	No	Not known
PC&C RESEARCH CORP.	2	1987	3,4,5,6	Yes	-0.55	No	Not known
POLYMORPHIC SYSTEMS*	2	1977	2,3	1985	0.81	No	7
QUADRANT COMPONENTS, INC.*	2	1982	3,4,5	Yes	-0.46	No	7
TANDY/RADIO SHACK*	2	1977	1,2,3,4,5,6	Yes	-0.69	Yes	9
UNISYS-CONVERGENT*	2	1980	2,3	1988	1.93	No	0
VALID LOGIC SYSTEMS*	2	1983	3,5	1987	9.88	No	0
WANG*	2	1977	2,3,4,5,6	Yes	0.13	Yes	8
WELLS AMERICAN	2	1979	1,2,3,4	1989	0.06	No	7
XEROX	2	1979	1,2,3,5	1986	1.73	No	9
ZENTEC*	2	1975	1,2,3,4	1990	0.17	No	1

Key continued on next page:

Table 5.32.2
A Closer Look at the Leaders and Their Actions
Key

** Denotes a firm that was a leader in its initial entry cycle.*
 # or last year shipped
[1] (Tegarden, 1992, p. 154)

0= su (start up): No firm revenues prior.
1= sb (single business): 95-100% of firm revenues in desk-top computers.
2= dc (dominant constrained): 70% of revenues in desk-top computers; remaining in other computer processors.
3= dl (dominant linked): 70% of revenues in desk-top computers; remaining in other electronic products.
4= dv (dominant vertical): 70% of revenues in desk-top computers; remaining in vertical or complementary products.
5= du (dominant unrelated): 70% of revenues in desk-top computers; remaining in products other than electronics.
6= rc (related constrained): 70% of firm revenues in computer processor products.
7= vr (vertical related): 70% of firm revenues in peripherals, software, or parts products.
8= rlc (related linked computers): 70% of firm revenues in computer products
9= rle (related linked electronics): 70% of firm revenues in electronics products
10= ur (unrelated): 30% of firm revenues not in electronics products.
11= foreign
12= not su (not startup)
13= probably su (probably a start up)

Hypotheses 1c and 1d test firm consistency of timing strategy when faced with an architectural technological change. Repeated here, the two hypotheses read:

H1c: Leaders are less likely to be leaders again when facing architectural innovation cycle changes.

and

H1d: Followers are more likely to be followers again when facing architectural innovation cycle changes.

These hypotheses are tested in the same manner as the hypotheses were tested in the same manner as the tests performed on Hypotheses 1a and 1b, with the exception that these hypotheses test firms as they enter the laptop market: an architectural technological change. Once again, we test the entrance into this cycle by all five different timing measures created. Testing of our dichotomous leader/follower measure is again accomplished with logistical analysis, while the other measures are tested using regular regression. Again, a one-tailed test of $p < .05$ is used to test for significance, and collinearity was not a concern as our VIF statistic was less than 5.

Table 5.33 presents the crosstabs of expected versus achieved results of leader and followers. As before, we see more leaders than expected becoming leaders and more followers than expected becoming followers. Tables 5.34.1 and 5.34.2 presents the results of our logistical regression of the leader/follower dichotomous variable (0=leader; 1=follower) of firms going into cycle 6. To find conclusive support for our assertion that leaders are less likely to be leaders again when faced with an architectural change, we would expect to see the sign for our leadership variable switch from positive to negative. As before, no significance was found with our leadership variable. Therefore, we find no evidence to support our claim that leaders will have a more difficult time begin leaders again when faced with an architectural change. We do, however, again find a significant negative relationship with our followers. This again indicates an increased probability that followers will be followers again in future cycles: even when facing architectural changes.

Table 5.33
Actual versus Expected Counts of Leader/Follower Entries
Cycle 6 Ending Cycle

Case 1 LF strat * Case 2 LF strategy Crosstabulation

			Case 2 LF strategy		
			0	1	Total
Case 1 LF strat	0	Count	3	5	8
		Expected Count	1.6	6.4	8.0
		% within Case 1 LF strat	37.5%	62.5%	100.0%
		% within Case 2 LF strategy	15.8%	6.3%	8.2%
		% of Total	3.1%	5.1%	8.2%
	1	Count	16	74	90
		Expected Count	17.4	72.6	90.0
		% within Case 1 LF strat	17.8%	82.2%	100.0%
		% within Case 2 LF strategy	84.2%	93.7%	91.8%
		% of Total	16.3%	75.5%	91.8%
Total		Count	19	79	98
		Expected Count	19.0	79.0	98.0
		% within Case 1 LF strat	19.4%	80.6%	100.0%
		% within Case 2 LF strategy	100.0%	100.0%	100.0%
		% of Total	19.4%	80.6%	100.0%

Tables 5.35.1 through 5.38.2 present the summaries of the regression equations used to test the other timing measures. Here we find very little support indicating that a firm's previous timing strategy influenced its timing into cycle 6 (laptops). We find no support for leaders being leaders again when faced with cycle 6, and no support for followers necessarily being followers when faced with cycle 6. We

do see significance with the subgroup "multi-cycled" firms. This may indicate that firms with histories of switching from cycle to cycle may be able to replicate its previous action more readily when faced with an architectural change than firms that have not experienced as many changes. This logic fits nicely with the notion that multiple switching patterns is indicative of firm flexibility. This displayed flexibility, even when experienced over incremental cycles, may aid the firm facing architectural changes.

With the results from our testing of firm timing efforts during architectural change, we cannot find support for either of our two hypotheses. We cannot say that leaders will not be leaders during architectural changes and we cannot say that followers will be followers again when faced with architectural changes. However, our data analysis has indicated that firms that are frequent switchers during incremental cycles may be more adept at continuing in their past timing efforts when faced with architectural change.

Table 5.34.1
Test of Hypotheses 1c and 1d
Logistic Regression
Leader/Follower Dichotomy Entering Cycle 6

DV= Case 2 LF	Full Models (n=94)			Leader 1st Entry Models (n=6)			Multi-Cycled Firm Models (n=86)		
	1	2	3	1	2	3	1	2	3
Constant	3.05^{***}	3.44	3.59^{*}	-7.66	-226.73	-226.73	3.25	3.46	3.62^{*}
New Entrant?	0.39	0.18	0.16	-66.06	-5045	-5045	-	-	-
Pop Density	-0.02^{*}	-0.02	-0.02^{*}	-	-	-	-0.02	-0.02	-0.02^{*}
Entry Size	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Price Premium Firm	1.26	1.39	1.50	22.58	1273.53	1273.53	0.65	0.72	0.75
Cycle Comp History		-0.10	-0.07		-59.94	-59.94		-0.06	-0.02
Case 1 LF			-1.55^{*}			-			-1.55^{*}
chi^2	9.17^{*}	0.09	3.05^{*}	1.79	3.62	5.41	5.96	0.03	3.08^{*}
-2 Log Likelihood	85.46	85.34	82.31	3.62	0.00	0.00	76.67	76.65	73.57

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

Table 5.34.2
Test of Hypotheses 1c and 1d
Logistic Regression
Leader/Follower Dichotomy Entering Cycle 6

DV= Case 2 LF	**Leader & Multi-Cycled Firm Models (n=5)**			**Follower 1st Entry Models (n=88)**			**Follower & Multi-Cycled Firm Models (n=81)**		
	1	2	3	1	2	3	1	2	3
Constant	-7.66	-226.73	-226.73	3.60^{***}	3.81	3.96^{*}	3.68^{***}	3.74	3.89^{*}
New Entrant?	-	-	-	0.20	0.09	0.05	-	-	-
Pop Density	-	-	-	-0.02^{*}	-0.02	-0.02^{*}	-0.02^{*}	-0.02	-0.02^{*}
Entry Size	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Price Premium Firm	22.58	1273.53	1273.63	2.52	2.58	2.76	1.58	1.60	1.68
Cycle Comp History		-59.94	-59.94		-0.06	-0.03		-0.02	0.01
Case 1 LF			-			-1.58^{*}			-1.56^{*}
chi^2	1.39	3.62	5.00	10.29^{*}	0.02	2.93^{*}	6.84^{*}	0.00	2.88^{*}
-2 Log Likelihood	3.62	0.00	0.00	78.88	78.86	75.93	70.78	70.78	67.90

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

Table 5.35.1
Test of Hypotheses 1c and 1d
Hierarchical Regression
Consistency of Ranking for Cycle 6

DV= Case 2 Ranking	**Full Models (n=94)**			**Leader 1st Entry Models (n=6)**			**Multi-Cycled Firm Models (n=86)**		
	1	2	3	1	2	3	1	2	3
Constant	105.27	104.24	90.34	-804.20	-2337.80	-	85.93	83.80	66.85
New Entrant?#	-0.17	-0.18	-0.19	8.75	26.96	-	-	-	-
Pop Density#	-0.28	-0.28	-0.28	-	-	-	-0.22	-0.22	-0.24
Entry Size#	0.04	0.04	0.08	1.61	3.16	-	0.04	0.04	0.09
Price Premium Firm#	0.08	0.08	0.12	9.59	26.85	-	0.07	0.07	0.10
Cycle Comp History#		0.02	0.04		-1.97	-		0.01	-0.03
Case 1 Ranking#			0.17			-			0.23*
ΔF	1.33	0.02	2.51	1.41	8.15	-	1.72	0.02	4.10*
ΔR^2	0.06	0.00	0.03	0.68	0.29	-	0.06	0.00	0.05
SE of Estimate	36.68	36.89	36.58	31.64	14.79	-	36.24	36.45	35.78

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.35.2
Test of Hypotheses 1c and 1d
Hierarchical Regression
Consistency of Ranking for Cycle 6

DV= Case 2 Ranking	**Leader & Multi-Cycled Firm Models (n=5)**			**Follower 1st Entry Models (n=88)**			**Follower & Multi-Cycled Firm Models (n=81)**		
	1	2	3	1	2	3	1	2	3
Constant	-46.89	-2.86	-	106.96	103.96	89.63	89.58	82.95	67.52**
New Entrant?#	-	-	-	-0.16	-0.18	-0.18	-	-	-
Pop Density#	-	-	-	-0.29	-0.29	-0.29	-0.24	-0.24	-0.25*
Entry Size#	1.57	3.08	-	-0.06	-0.07	-0.02	-0.06	-0.08	0.01
Price Premium Firm#	1.15	3.21	-	0.08	0.08	0.10	0.08	0.07	0.10
Cycle Comp History#		-1.20	-		0.06	0.06		-5.00	0.05
Case 1 Ranking#			-			0.16			0.21*
ΔF	1.92	8.15	-	1.34	0.16	1.82	1.84	0.16	3.08*
ΔR^2	0.66	0.31	-	0.06	0.00	0.02	0.07	0.00	0.04
SE of Estimate	31.64	14.79	-	36.93	37.12	36.94	36.22	36.42	35.93

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.36.1
Test of Hypotheses 1c and 1d
Hierarchical Regression
Consistency of Z Score for Cycle 6

DV= Case 2 Z Score	Full Models (n=94)			Leader 1st Entry Models (n=6)			Multi-Cycled Firm Models (n=86)		
	1	2	3	1	2	3	1	2	3
Constant	1.41	1.45	1.34	-18.40	-60.60	-	0.78*	0.86	0.84
New Entrant?#	-0.21	-0.20	-0.19	7.13	26.52	-	-	-	-
Pop Density#	-0.34	-0.34	-0.34	-	-	-	-0.27**	-0.27	-0.29**
Entry Size#	0.04	0.04	0.07	1.45	3.10	-	0.04	0.04	-0.08
Price Premium Firm#	0.09	0.09	0.13	7.95	26.32	-	0.07	0.07	0.09
Cycle Comp History#		-0.02	-0.01		-2.09	-		-0.02	0.00
Case 1 Z Score#			0.16			-			0.19*
ΔF	1.85	0.03	2.23	1.10	6.06	-	2.43*	0.04	3.13*
ΔR^2	0.08	0.00	0.02	0.62	0.32	-	0.08	0.00	0.03
SE of Estimate	0.98	0.98	0.98	0.89	0.47	-	0.97	0.97	0.96

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.36.2
Test of Hypotheses 1c and 1d
Hierarchical Regression
Consistency of Z Score for Cycle 6

DV= Case 2 Z Score	Leader & Multi-Cycled Firm Models (n=5)			Follower 1st Entry Models (n=88)			Follower & Multi-Cycled Firm Models (n=81)		
	1	2	3	1	2	3	1	2	3
Constant	-2.44	-1.23	-	1.46*	1.42	1.22	0.90**	0.82	0.81
New Entrant?#	-	-	-	-0.19	-0.20	-0.17	-	-	-
Pop Density#	-	-	-	-0.35**	-0.35	-0.34	-0.29**	-0.29	-0.30
Entry Size#	1.43	3.06	-	-0.09	-0.10	-0.06	-0.11	-0.11	-0.06
Price Premium Firm#	0.96	3.18	-	0.08	0.08	0.09	0.08	0.07	0.09
Cycle Comp History#		-1.29	-		0.03	0.04		0.02	0.03
Case 1 Z Score#			-			0.16			0.17
ΔF	1.43	6.06	-	1.98*	0.04	1.91	2.77*	0.03	2.10
ΔR^2	0.59	0.35	-	0.09	0.00	0.02	0.10	0.00	0.03
SE of Estimate	0.89	0.47	-	0.98	0.99	0.98	0.96	0.97	0.96

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.37.1
Test of Hypotheses 1c and 1d
Hierarchical Regression
Consistency of Months from Pioneer for Cycle 6

DV= Case 2 Mths from Pioneer	Full Models (n=94)			Leader 1st Entry Models (n=6)			Multi-Cycled Firm Models (n=86)		
	1	2	3	1	2	3	1	2	3
Constant	84.64	85.93	73.85	-366.36	-1327.27	-	70.14***	72.14	51.07**
New Entrant? #	-0.21	-0.20	-0.21	7.13	26.52	-	-	-	-
Pop Density #	-0.34	-0.34	-0.37	-	-	-	-0.27**	-0.27	-0.32**
Entry Size #	0.04	0.04	0.06	1.45	3.10	-	0.04	0.04	0.08
Price Premium Firm #	0.09	0.09	0.12	7.95	26.32	-	0.07	0.07	0.09
Cycle Comp History #		-0.02	-0.01		-2.09	-		-0.02	0.00
Case 1 Mths from Pioneer #			0.12			-			0.19*
ΔF	1.85	0.03	1.10	1.10	6.06	-	2.43*	0.04	2.95*
ΔR^2	0.08	0.00	0.01	0.62	0.32	-	0.08	0.00	0.03
SE of Estimate	22.25	22.37	22.36	20.19	10.75	-	21.99	22.12	21.86

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.37.2
Test of Hypotheses 1c and 1d
Hierarchical Regression
Consistency of Months from Pioneer for Cycle 6

DV= Case 2 Mths from Pioneer	Leader & Multi-Cycled Firm Models (n=5)			Follower 1st Entry Models (n=88)			Follower & Multi-Cycled Firm Models (n=81)		
	1	2	3	1	2	3	1	2	3
Constant	-3.05	24.54	-	85.75^{***}	84.86	73.20	73.00^{***}	71.23	53.32
New Entrant? #	-	-	-	-0.19	-0.20	-0.20	-	-	-
Pop Density #	-	-	-	-0.35^{**}	-0.35	-0.37	-0.29^{**}	-0.29	-0.32
Entry Size #	1.43	3.06	-	-0.09	-0.10	-0.07	-0.11	-0.11	-0.07
Price Premium Firm #	0.96	3.18	-	0.08	0.08	0.09	-0.08	-0.07	0.09
Cycle Comp History #		-1.29	-		0.03	0.04		-0.02	0.03
Case 1 Mths from Pioneer #			-			0.10			-17.00
Δ F	1.43	6.06	-	1.98^{*}	0.04	0.74	2.77^{*}	0.03	1.97
ΔR^2	0.59	0.35	-	0.09	0.00	0.01	0.10	0.00	0.02
SE of Estimate	20.19	10.75	-	22.39	22.52	22.55	21.95	22.09	21.95

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.38.1
Test of Hypotheses 1c and 1d
Hierarchical Regression
Consistency of Standard Months from Pioneer for Cycle 6

DV= Case 2 Std Mths from Pioneer	Full Models (n=94)			Leader 1st Entry Models (n=6)			Multi-Cycled Firm Models (n=86)		
	1	2	3	1	2	3	1	2	3
Constant	3.74	3.78	2.44^{**}	-16.21	-58.71	-	3.10^{***}	3.19	2.14^{**}
New Entrant? #	-0.21	-0.20	-0.14	7.13	26.52	-	-	-	-
Pop Density #	-0.34	-0.34	-0.31^{*}	-	-	-	-0.27^{**}	-0.27	-0.27^{**}
Entry Size #	0.04	0.04	0.08	1.45	3.10	-	0.04	0.04	0.08
Price Premium Firm #	0.09	0.09	0.13	7.95	26.32	-	0.07	0.07	0.09
Cycle Comp History #		-0.02	0.00		-2.09	-		-0.02	0.00
Case 1 Mths from Pioneer #			0.22^{*}			-			0.19^{*}
Δ F	1.85	0.03	3.89^{*}	1.10	6.06	-	2.43^{*}	0.04	3.11^{*}
ΔR^2	0.08	0.00	0.04	0.62	0.32	-	0.08	0.00	0.03
SE of Estimate	0.98	0.99	0.97	0.89	0.47	-	0.97	0.98	0.97

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

Table 5.38.2
Test of Hypotheses 1c and 1d
Hierarchical Regression
Consistency of Standard Months from Pioneer for Cycle 6

DV= Case 2 Std Mths from Pioneer	**Leader & Multi-Cycled Firm Models (n=5)**			**Follower 1st Entry Models (n=88)**			**Follower & Multi-Cycled Firm Models (n=81)**		
	1	2	3	1	2	3	1	2	3
Constant	-0.14	1.09	-	3.79^{***}	3.75	2.28^{*}	3.23^{***}	3.15	2.25
New Entrant? #	-	-	-	-0.19	-0.20	-0.12	-	-	-
Pop Density #	-	-	-	-0.35^{**}	-0.35	-0.31^{*}	-0.29^{**}	-0.29	-0.29
Entry Size #	1.43	3.06	-	-0.09	-0.10	-0.05	-0.11	-0.11	-0.07
Price Premium Firm #	0.96	3.18	-	0.08	0.08	0.10	-0.08	-0.07	0.09
Cycle Comp History #		-1.29	-		0.03	0.05		-0.02	0.03
Case 1 Mths from Pioneer #			-			0.22^{*}			0.17
Δ F	1.43	6.06	-	1.98^{*}	0.04	3.46^{*}	2.77^{*}	0.03	2.12
ΔR^2	0.59	0.35	-	0.09	0.00	0.04	0.10	0.00	0.03
SE of Estimate	0.89	0.48	-	0.99	1.00	0.98	0.97	0.98	0.97

One-Tailed Test:

$p < .05$

$p < .01$

$p < .001$

#= Standardized Coefficient

5.2 Market Share Hypotheses Results

Research question 2 inquires as to the impact consistent timing strategies have on firm performance. As such, two sets of hypotheses are formed to be tested: one set that examines the impact of timing consistency on market share, and a second that examines the impact of timing consistency on survival. In this section we examine the impact of timing consistency on market share with the following set of hypotheses:

H2a: Leaders that repeat as leaders will realize higher market share than those leaders that switch to follower patterns during incremental technological changes.

H2b: Followers that repeat as followers will realize higher market share than those followers that switch to leader patterns during incremental technological changes.

H2c: Leaders that repeat as leaders will realize lower market share than those leaders that switch to follower patterns when faced with architectural technological changes.

H2d: Followers that repeat as followers will realize higher market share than those followers that switch to leader patterns when faced with architectural technological changes.

The market share and consistency relationship is tested at two levels. The first, a cycle level analysis, tests a firm's consistency of entry against the market share it achieved in the successive cycle. Of particular interest with this test, is the unique contribution that timing consistency, and the benefits associated with it, makes to market share. Market share is measured at two points: 1988 and 1991. The market share measure at 1988 represents the average market share of a firm's total sales in a specific market cycle relative to its competitors within that cycle. The 1988 measure is intended to measure industry conditions before the impact of an architectural technological change is introduced to the market. The 1991 market share measure is intended to measure firm market share after the introduction of the architectural change.

In the cycle level analysis, a firm level consistency rating is created for all five timing measures used from Hypotheses 1. It is this firm consistency measure that serves as our independent variable. Hierarchical regression, with a single-tailed test of $p<.05$ is used for this test. Model 1 of the analysis regresses the control variable case 1 market share against our case 2 dependent variable. The second step includes our two other control variables: firm pricing strategy and firm rank entry into the successive cycle. Next, indicator variables are included to identify unique industry conditions within cycles. Finally, our timing consistency variable is included. These models are applied first to "leader" firms, and then to our "follower" firms.

Tables 5.39 through 5.48 provide the details of our regression results. Unfortunately, we found no significant results for our leader models. This may be due to the low number of firms that were able to be included in the test. As describes in the qualitative study offered in our discussion of Hypotheses 1a through 1d, many of the firms that repeated as leaders in multiple cycles were among the top 25 in terms of sales dollars. However, we lack the ability to say with certainty that an association exists between leadership timing consistency and market share.

For firms that began as leaders, we found a firm's previous market share to be a significant predictor of future market share in every consistency measure employed. As well, we found the indicator variable for cycle 4 to be significant in all of the models, indicating that participation in cycle 4 to be a strong contributor to firm market share in 1988. Our analysis of followers shows that the ranking sequential consistency measure and its standardization, z score consistency, are both significant indicators of firm market share in 1988. However, the direction of this influence is negative, opposite of our hypothesized relationship.

To further test this assertion, we tested timing consistency at the firm level as well. While utilizing the same timing consistency variable as the one used in the previous test, this test uses an overall firm market share as the dependent variable instead of the results of a single cycle. This test allows us to test the consistency measure against the whole of a firm's offerings, instead of isolating individual results. In doing so, we do not penalize a firm that may be competing in multiple markets at the same time. Once again, we use a firm's pricing strategy and rank entry as control measures and took market share measurements for 1988 and 1991.

The results of the hierarchical regression tests can be found in tables 5.49 through 5.58. As we found in the cycle level analysis, no significant relationships were found for our leader group. Further, only rank entry was found to be significant for the follower group breakdown. As such, we find no support for our hypotheses regarding timing strategy and market share during incremental cycle changes.

To test for the impact of architectural changes on the relationship between firm timing strategy and market share, we repeated our market share measurements taken in the incremental cycle testing for the year 1991. 1991 represents several years of performance outcomes associated with the commercialization of laptop computers, and thus, and disruptive results that ay have occurred from their introduction should be measurable by this time. Once again, our control variables add explanatory power to the 1991 market share variable, however neither leader nor follower timing consistencies seem to add anything to our ability to explain market share. The exception to this is once again our ranking and z score consistency measures, which both provide weak, yet significant contributions to our dependent variable. As was the case with the cycle level analysis, the ranking sequential and z-score sequential measures are both negative, thus indicating that consistent timing efforts negatively affect a firm's market share in successive cycles. We therefore find weak support for Hypothesis 2c, that timing consistency negatively affects firm market share during architectural cycle changes with our cycle level analysis.

Finally, we examine our firm level architectural change analyses. The firm level analysis of leader firms show that our leader/follower dichotomous measure, our ranking consistency variable, and our z-score consistency variable all show a significant, negative relationship between leader consistency timing strategies and market share. No such relationship was found for our follower calculations, however.

In conclusion, neither leaders nor follower consistency timing strategies were found to positively influence market share during incremental technological change cycles. Only weak significance was found, and that support was not in our hypothesized direction. However, we found strong support that timing consistency by leader firms during architectural cycle changes can be detrimental to firm market share as hypothesized in Hypothesis 2c. No such support was found for our follower hypothesis, however.

Table 5.39
Regression Model Estimates to Test Hypothesis 2a-2d
LF Sequential Consistency Measure
For Firms that Began As Leaders

DV= Market Share	Data Test for 1988 MS (n= 21)				Data Test for 1991 MS (n= 27)			
	Block 1	Block 2	Block 3	Block 4	Block 1	Block 2	Block 3	Block 4
Intercept	0.04	0.10	0.18	0.34	0.03*	0.04	0.05*	0.09
Case 1 Market Share#	0.12	0.03	-0.10	-0.19	0.62***	0.58	0.96***	0.87
Price Premium Firm#		-0.05	0.06	0.29		-0.01	0.06	0.06
Ending Cycle Rank Entry#		-0.44	-0.72	-0.68		-0.15	-0.21	-0.20
Cycle 2 Indicator#			-0.10	-0.06			0.42**	0.43
Case 3 Indicator#			-	-			-0.54**	-0.47
Cycle 4 Indicator#			-0.40	-0.36			-0.08	-0.10
Cycle 5 Indicator#			-0.19	-0.12			-	-
Cycle 6 Indicator#			-0.49	-0.51			-0.18	-0.17
Sequential Consistency#				-0.42				-0.11
F	0.26	1.41	1.17	1.43	15.43***	5.17	7.79***	6.73
R^2	0.01	0.20	0.39	0.49	0.38	0.40	0.74	0.75
Std. Error of Estimate	0.09	0.08	0.08	0.08	0.07	0.07	0.05	0.05

= Standardized Coefficient One-tailed test: * $p < .05$; ** $p < .01$; *** $p < .001$

Table 5.40
Regression Model Estimates to Test Hypothesis 2a-2d
Ranking Sequential Consistency Measure
For Firms that Began As Leaders

DV= Market Share	Data Test for 1988 MS (n= 21)				Data Test for 1991 MS (n= 27)			
	Block 1	Block 2	Block 3	Block 4	Block 1	Block 2	Block 3	Block 4
Intercept	0.04	0.10	0.18	0.21	0.03*	0.04	0.05*	0.05
Case 1 Market Share#	0.12	0.03	-0.10	-0.18	0.62***	0.58	0.96***	0.93
Price Premium Firm#		-0.05	0.06	0.06		-0.01	0.06	0.05
Ending Cycle Rank Entry#		-0.44	-0.72	-0.63		-0.15	-0.21	-0.18
Cycle 2 Indicator#			-0.10	-0.09			0.42**	0.42
Case 3 Indicator#			-	-			-0.54**	-0.52
Cycle 4 Indicator#			-0.40	-0.45			-0.08	-0.07
Cycle 5 Indicator#			-0.19	-0.21			-	-
Cycle 6 Indicator#			-0.49	-0.47			-0.18	-0.17
Sequential Consistency#				-0.22				-0.06
F	0.26	1.41	1.17	1.06	15.43***	5.17	7.79***	6.51
R^2	0.01	0.20	0.39	0.41	0.38	0.40	0.74	0.74
Std. Error of Estimate	0.09	0.08	0.08	0.08	0.07	0.07	0.05	0.05

#= Standardized Coefficient One-tailed test: * $p < .05$; ** $p < .01$; *** $p < .001$

Table 5.41
Regression Model Estimates to Test Hypothesis 2a-2d
Z Score Sequential Consistency Measure
For Firms that Began As Leaders

DV= Market Share	Data Test for 1988 MS (n= 21)				Data Test for 1991 MS (n= 27)			
	Block 1	Block 2	Block 3	Block 4	Block 1	Block 2	Block 3	Block 4
Intercept	0.04	0.10	0.18	0.22	0.03^{*}	0.04	0.05^{*}	0.05
Case 1 Market Share#	0.12	0.03	-0.10	-0.14	0.62^{***}	0.58	0.96^{***}	0.95
Price Premium Firm#		-0.05	0.06	0.44		-0.01	0.06	0.07
Ending Cycle Rank Entry#		-0.44	-0.72	-0.55		-0.15	-0.21	-0.20
Cycle 2 Indicator#			-0.10	-0.11			0.42^{**}	0.41
Case 3 Indicator#			-	-			-0.54^{**}	-0.54
Cycle 4 Indicator#			-0.40	-0.42			-0.08	-0.08
Cycle 5 Indicator#			-0.19	-0.15			-	-
Cycle 6 Indicator#			-0.49	-0.43			-0.18	-0.17
Sequential Consistency#				-0.49				-0.03
F	0.26	1.41	1.17	1.14	15.43^{***}	5.17	7.79^{***}	6.47
R^2	0.12	0.45	0.62	0.66	0.38	0.40	0.74	0.74
Std. Error of Estimate	0.09	0.08	0.08	0.08	0.07	0.07	0.05	0.05

#= Standardized Coefficient   One-tailed test: * $p < .05$; ** $p < .01$; *** $p < .001$

Table 5.42
Regression Model Estimates to Test Hypothesis 2a-2d
Months from Pioneering Firm Sequential Consistency Measure
For Firms that Began As Leaders

DV= Market Share	Data Test for 1988 MS (n= 21)				Data Test for 1991 MS (n= 27)			
	Block 1	Block 2	Block 3	Block 4	Block 1	Block 2	Block 3	Block 4
Intercept	0.04	0.10	0.18	0.18	0.03^{*}	0.04	0.05^{*}	0.05
Case 1 Market Share#	0.12	0.03	-0.10	-0.10	0.62^{***}	0.58	0.96^{***}	0.97
Price Premium Firm#		-0.05	0.06	0.06		-0.01	0.06	0.06
Ending Cycle Rank Entry#		-0.44	-0.72	-0.72		-0.15	-0.21	-0.22
Cycle 2 Indicator#			-0.10	-0.10			0.42^{**}	0.41
Case 3 Indicator#			-	-			-0.54^{**}	-0.55
Cycle 4 Indicator#			-0.40	-0.40			-0.08	-0.08
Cycle 5 Indicator#			-0.19	-0.19			-	-
Cycle 6 Indicator#			-0.49	-0.49			-0.18	-0.18
Sequential Consistency#				-0.00				0.03
F	0.26	1.41	1.17	0.94	15.43^{***}	5.17	7.79^{***}	6.48
R^2	0.01	0.20	0.39	0.39	0.38	0.40	0.74	0.74
Std. Error of Estimate	0.09	0.08	0.08	0.09	0.07	0.07	0.05	0.05

= Standardized Coefficient One-tailed test: $^{*}\ p < .05$; $^{**}\ p < .01$; $^{***}\ p < .001$

Table 5.43
Regression Model Estimates to Test Hypothesis 2a-2d
Standardized Months from Pioneering Firm Sequential Consistency Measure
For Firms that Began As Leaders

DV= Market Share	Data Test for 1988 MS (n= 21)				Data Test for 1991 MS (n= 27)			
	Block 1	Block 2	Block 3	Block 4	Block 1	Block 2	Block 3	Block 4
Intercept	0.04	0.10	0.18	0.19	0.03^{*}	0.04	0.05^{*}	0.05
Case 1 Market Share#	0.12	0.03	-0.10	-0.11	0.62^{***}	0.58	0.96^{***}	0.97
Price Premium Firm#		-0.05	0.06	0.06		-0.01	0.06	0.06
Ending Cycle Rank Entry#		-0.44	-0.72	-0.71		-0.15	-0.21	-0.22
Cycle 2 Indicator#			-0.10	-0.10			0.42^{**}	0.41
Case 3 Indicator#			-	-			-0.54^{**}	-0.54
Cycle 4 Indicator#			-0.40	-0.41			-0.08	-0.08
Cycle 5 Indicator#			-0.19	-0.18			-	-
Cycle 6 Indicator#			-0.49	-0.48			-0.18	-0.18
Sequential Consistency#				-0.06				0.01
F	0.26	1.41	1.17	0.95	15.43^{***}	5.17	7.79^{***}	6.46
R^2	0.01	0.20	0.39	0.39	0.38	0.40	0.74	0.74
Std. Error of Estimate	0.09	0.08	0.08	0.09	0.07	0.07	0.05	0.05

#= Standardized Coefficient One-tailed test: * $p < .05$; ** $p < .01$; *** $p < .001$

Table 5.44
Regression Model Estimates to Test Hypothesis 2a-2d
LF Sequential Consistency Measure
For Firms that Began As Followers

DV= Market Share	Data Test for 1988 MS (n= 257)				Data Test for 1991 MS (n= 381)			
	Block 1	Block 2	Block 3	Block 4	Block 1	Block 2	Block 3	Block 4
Intercept	0.01*	0.02***	0.00	0.01	0.00***	0.01***	0.01	0.01
Case 1 Market Share#	0.36***	0.34***	0.36***	0.36	0.38***	0.36***	0.39	0.39
Price Premium Firm#		0.06	0.06	0.07		0.14**	0.14	0.16
Ending Cycle Rank Entry#		-0.13*	-0.03	-0.07		-0.16***	-0.13	-0.17
Cycle 2 Indicator#			0.07	0.06			-	-
Case 3 Indicator#			-	-			-0.08	-0.08
Cycle 4 Indicator#			0.26***	0.27			0.03	0.01
Cycle 5 Indicator#			-0.03	-0.04			-	-
Cycle 6 Indicator#			0.05	0.03			0.05	0.03
Sequential Consistency#				-0.10				-0.08
F	36.98***	15.00*	9.53***	8.66	63.06***	30.58***	15.95	14.01
R^2	0.13	0.15	0.21	0.22	0.14	0.20	0.20	0.21
Std. Error of Estimate	0.04	0.04	0.04	0.04	0.01	0.01	0.01	0.01

#= Standardized Coefficient One-tailed test: * $p < .05$; ** $p < .01$; *** $p < .001$

Table 5.45
Regression Model Estimates to Test Hypothesis 2a-2d
Ranking Sequential Consistency Measure
For Firms that Began As Followers

DV= Market Share	Data Test for 1988 MS (n= 257)				Data Test for 1991 MS (n= 381)			
	Block 1	Block 2	Block 3	Block 4	Block 1	Block 2	Block 3	Block 4
Intercept	0.01*	0.02***	0.00	0.01	0.00***	0.01***	0.01	0.01***
Case 1 Market Share#	0.36***	0.34***	0.36***	0.34***	0.38***	0.36***	0.39	0.39***
Price Premium Firm#		0.06	0.06	0.06		0.14**	0.14	0.13**
Ending Cycle Rank Entry#		-0.13*	-0.03	0.04		-0.16***	-0.13	-0.09
Cycle 2 Indicator#			0.07	0.07			-	-
Case 3 Indicator#			-	-			-0.08	-0.09*
Cycle 4 Indicator#			0.26***	0.31***			0.03	0.05
Cycle 5 Indicator#			-0.03	0.01			-	-
Cycle 6 Indicator#			0.05	0.08			0.05	0.07
Sequential Consistency#				-0.15**				-0.10*
F	36.98***	15.00**	9.53***	9.32**	63.06***	30.58***	15.95	14.39*
R^2	0.13	0.15	0.19	0.21	0.14	0.20	0.20	0.21
Std. Error of Estimate	0.04	0.04	0.04	0.04	0.01	0.01	0.01	0.01

#= Standardized Coefficient One-tailed test: * p < .05; ** p < .01; *** p < .001

Table 5.46
Regression Model Estimates to Test Hypothesis 2a-2d
Z Score Sequential Consistency Measure
For Firms that Began As Followers

DV= Market Share	Data Test for 1988 MS (n= 257)				Data Test for 1991 MS (n= 381)			
	Block 1	Block 2	Block 3	Block 4	Block 1	Block 2	Block 3	Block 4
Intercept	0.01*	0.02***	0.00	0.02*	0.00***	0.01***	0.01	0.01***
Case 1 Market Share#	0.36***	0.34***	0.36***	0.34***	0.38***	0.36***	0.39	0.39***
Price Premium Firm#		0.06	0.06	0.08		0.14**	0.14	0.16***
Ending Cycle Rank Entry#		-0.13*	-0.03	-0.07		-0.16***	-0.13	-0.14***
Cycle 2 Indicator#			0.07	0.07			-	-
Case 3 Indicator#			-	-			-0.08	-0.09*
Cycle 4 Indicator#			0.26***	0.29***			0.03	0.03
Cycle 5 Indicator#			-0.03	-0.03			-	-
Cycle 6 Indicator#			0.05	0.03			0.05	0.05
Sequential Consistency#				-0.17**				-0.12**
F	36.98***	15.00*	9.53***	9.50**	65.06***	30.58***	15.95	14.72**
R^2	0.13	0.15	0.21	0.24	0.14	0.20	0.20	0.22
Std. Error of Estimate	0.04	0.04	0.04	0.04	0.01	0.01	0.01	0.01

#= Standardized Coefficient One-tailed test: * p < .05; ** p < .01; *** p < .001

Table 5.47
Regression Model Estimates to Test Hypothesis 2a-2d
Months from Pioneering Firm Sequential Consistency Measure
For Firms that Began As Followers

DV= Market Share	Data Test for 1988 MS (n= 257)				Data Test for 1991 MS (n= 381)			
	Block 1	Block 2	Block 3	Block 4	Block 1	Block 2	Block 3	Block 4
Intercept	0.01^{*}	0.02^{***}	0.00	0.01	0.00^{***}	0.01^{***}	0.01	0.01
Case 1 Market Share#	0.36^{***}	0.34^{***}	0.36^{***}	0.36	0.38^{***}	0.36^{***}	0.39	0.39
Price Premium Firm#		0.06	0.06	0.06		0.14^{**}	0.14	0.14
Ending Cycle Rank Entry#		-0.13^{*}	-0.03	-0.03		-0.16^{***}	-0.13	-0.12
Cycle 2 Indicator#			0.07	0.06			-	-
Case 3 Indicator#			-	-			-0.08	-0.08
Cycle 4 Indicator#			0.26^{***}	0.27			0.03	0.03
Cycle 5 Indicator#			-0.03	-0.02			-	-
Cycle 6 Indicator#			0.05	0.05			0.05	0.05
Sequential Consistency#				-0.05				-0.03
F	36.98^{***}	15.00^{*}	9.53^{***}	8.41	63.06^{***}	30.58^{***}	15.95	13.71
R^2	0.13	0.15	0.21	0.21	0.14	0.20	0.20	0.21
Std. Error of Estimate	0.04	0.04	0.04	0.04	0.01	0.01	0.01	0.01

#= Standardized Coefficient One-tailed test: * $p < .05$; ** $p < .01$; *** $p < .001$

Table 5.48
Regression Model Estimates to Test Hypothesis 2a-2d
Standardized Months from Pioneering Firm Sequential Consistency Measure
For Firms that Began As Followers

DV= Market Share	Data Test for 1988 MS (n= 257)				Data Test for 1991 MS (n= 381)			
	Block 1	Block 2	Block 3	Block 4	Block 1	Block 2	Block 3	Block 4
Intercept	0.01*	0.02***	0.00	-0.00	0.00***	0.01***	0.01	0.01
Case 1 Market Share#	0.36***	0.34***	0.36***	0.35	0.38***	0.36***	0.39	0.39
Price Premium Firm#		0.05	0.06	0.05		0.14**	0.14	0.14
Ending Cycle Rank Entry#		-0.13*	-0.03	-0.01		-0.16***	-0.13	-0.13
Cycle 2 Indicator#			0.07	0.06			-	-
Case 3 Indicator#			-	-			-0.08	-0.08
Cycle 4 Indicator#			0.26***	0.26			0.03	0.03
Cycle 5 Indicator#			-0.03	-0.01			-	-
Cycle 6 Indicator#			0.05	0.04			0.05	0.06
Sequential Consistency#				0.06				-0.02
F	36.98***	15.00*	9.53***	8.42	63.06***	30.58***	15.95	13.67
R^2	0.13	0.15	0.21	0.21	0.14	0.20	0.20	0.20
Std. Error of Estimate	0.04	0.04	0.04	0.04	0.01	0.01	0.01	0.01

#= Standardized Coefficient One-tailed test: * p < .05; ** p < .01; *** p < .001

Table 5.49
Regression Model Estimates to Test Hypothesis 2a-2d
LF Sequential Consistency Measure
For Firms that Began As Leaders

DV= Market Share	Data Test for 1988 MS (n= 14)		Data Test for 1991 MS (n= 14)	
	Block 1	Block 2	Block 1	Block 2
Intercept	0.06	0.09	0.08	0.30**
Price Premium Firm#	-0.33	-0.31	-0.31	-0.45*
Initial Rank Entry#	-0.15	-0.18	-0.28	-0.29
Sequential Consistency#		-0.09		-0.61*
F	0.91	0.59	1.31	3.86*
R^2	0.14	0.15	0.19	0.54
Std. Error of Estimate	0.11	0.11	0.09	0.07

#= Standardized Coefficients
One-tailed test:
* p < .05
** p < .01
*** p < .001

Table 5.50
Regression Model Estimates to Test Hypothesis 2a-2d
Ranking Sequential Consistency Measure
For Firms that Began As Leaders

DV= Market Share	Data Test for 1988 MS (n= 14)		Data Test for 1991 MS (n= 14)	
	Block 1	Block 2	Block 1	Block 2
Intercept	0.06	0.11	0.08	0.15**
Price Premium Firm#	-0.33	-0.26	-0.31	-0.18
Initial Rank Entry#	-0.15	-0.24	-0.28	-0.38
Sequential Consistency#		-0.25		-0.49*
F	0.91	0.78	1.31	2.29*
R^2	0.14	0.19	0.19	0.41
Std. Error of Estimate	0.11	0.11	0.09	0.08

#= Standardized Coefficients
One-tailed test:
* p < .05
** p < .01
*** p < .001

Table 5.51
Regression Model Estimates to Test Hypothesis 2a-2d
Z Score Sequential Consistency Measure
For Firms that Began As Leaders

DV= Market Share	Data Test for 1988 MS (n= 14)		Data Test for 1991 MS (n= 14)	
	Block 1	Block 2	Block 1	Block 2
Intercept	0.06	0.16	0.08	0.17^{**}
Price Premium Firm#	-0.33	-0.22	-0.31	-0.99
Initial Rank Entry#	-0.15	-0.38	-0.28	-1.90^{*}
Sequential Consistency#		-0.39		-0.54^{*}
F	0.91	1.03	1.31	2.56^{*}
R^2	0.14	0.24	0.19	0.44
Std. Error of Estimate	0.11	0.11	0.09	0.08

#= Standardized Coefficients
One-tailed test:
* p < .05
** p < .01
*** p < .001

Table 5.52
Regression Model Estimates to Test Hypothesis 2a-2d
Months from Pioneering Firm Sequential Consistency Measure
For Firms that Began As Leaders

DV= Market Share	Data Test for 1988 MS (n= 14)		Data Test for 1991 MS (n= 14)	
	Block 1	Block 2	Block 1	Block 2
Intercept	0.06	0.23	0.08	0.18
Price Premium Firm#	-0.33	-0.21	-0.31	-0.24
Initial Rank Entry#	-0.15	-0.54	-0.28	-0.53
Sequential Consistency #		-0.55		-0.47
F	0.91	1.28	1.31	1.80
R^2	0.14	0.28	0.19	0.35
Std. Error of Estimate	0.11	0.11	0.09	0.08

#= Standardized Coefficients
One-tailed test:
* p < .05
** p < .01
*** p < .001

Table 5.53
Regression Model Estimates to Test Hypothesis 2a-2d
Standardized Months from Pioneering Firm Sequential Consistency Measure
For Firms that Began As Leaders

DV= Market Share	Data Test for 1988 MS (n= 14)		Data Test for 1991 MS (n= 14)	
	Block 1	Block 2	Block 1	Block 2
Intercept	0.06	0.22	0.08	0.09
Price Premium Firm#	-0.33	-0.17	-0.31	-0.28
Initial Rank Entry#	-0.15	-0.46	-0.28	-0.27
Sequential Consistency#		-0.44		-0.09
F	0.91	0.97	1.31	0.83
R^2	0.14	0.23	0.19	0.20
Std. Error of Estimate	0.11	0.11	0.09	0.09

#= Standardized Coefficients
One-tailed test:
* $p < .05$
** $p < .01$
*** $p < .001$

Table 5.54
Regression Model Estimates to Test Hypothesis 2a-2d
LF Sequential Consistency Measure
For Firms that Began As Followers

DV= Market Share	Data Test for 1988 MS (n= 148)		Data Test for 1991 MS (n= 228)	
	Block 1	Block 2	Block 1	Block 2
Intercept	0.01***	0.01	0.01***	0.01
Price Premium Firm#	-0.05	-0.05	0.02	0.01
Initial Rank Entry#	-0.24**	-0.24	-0.22***	-0.23
Sequential Consistency#		-0.03		-0.05
F	4.34**	2.92	5.79**	4.02
R^2	0.06	0.06	0.05	0.05
Std. Error of Estimate	0.01	0.01	0.01	0.01

#= Standardized Coefficients
One-tailed test:
* $p < .05$
** $p < .01$
*** $p < .001$

Table 5.55
Regression Model Estimates to Test Hypothesis 2a-2d
Ranking Sequential Consistency Measure
For Firms that Began As Followers

DV= Market Share	Data Test for 1988 MS (n= 148)		Data Test for 1991 MS (n= 228)	
	Block 1	Block 2	Block 1	Block 2
Intercept	0.01***	0.01	0.01***	0.01
Price Premium Firm#	-0.05	-0.04	0.02	0.01
Initial Rank Entry#	-0.24**	-0.22	-0.22***	-0.20
Sequential Consistency#		-0.07		-0.04
F	4.34**	3.09	5.79**	3.94
R^2	0.06	0.06	0.05	0.05
Std. Error of Estimate	0.01	0.01	0.01	0.01

= Standardized Coefficients
One-tailed test:
* p < .05
** p < .01
*** p < .001

Table 5.56
Regression Model Estimates to Test Hypothesis 2a-2d
Z Score Sequential Consistency Measure
For Firms that Began As Followers

DV= Market Share	Data Test for 1988 MS (n= 148)		Data Test for 1991 MS (n= 228)	
	Block 1	Block 2	Block 1	Block 2
Intercept	0.01^{***}	0.01	0.01^{***}	0.01
Price Premium Firm#	-0.05	-0.05	0.02	0.02
Initial Rank Entry#	-0.24^{**}	-0.24	-0.22^{***}	-0.22
Sequential Consistency#		0.02		0.01
F	4.34^{**}	2.89	5.79^{**}	3.86
R^2	0.06	0.06	0.05	0.05
Std. Error of Estimate	0.01	0.01	0.01	0.01

#= Standardized Coefficients
One-tailed test:
* p < .05
** p < .01
*** p < .001

Table 5.57
Regression Model Estimates to Test Hypothesis 2a-2d
Months from Pioneering Firm Sequential Consistency Measure
For Firms that Began As Followers

DV= Market Share	Data Test for 1988 MS (n= 148)		Data Test for 1991 MS (n= 228)	
	Block 1	Block 2	Block 1	Block 2
Intercept	0.01***	0.01	0.01***	0.01
Price Premium Firm#	-0.05	-0.06	0.02	0.02
Initial Rank Entry#	-0.24**	-0.27	-0.22***	-0.23
Sequential Consistency#		0.10		0.03
F	4.34**	3.29	5.79**	3.89
R^2	0.06	0.06	0.05	0.05
Std. Error of Estimate	0.01	0.01	0.01	0.01

#= Standardized Coefficients
One-tailed test:
* p < .05
** p < .01
*** p < .001

Table 5.58
Regression Model Estimates to Test Hypothesis 2a-2d
Standardized Months from Pioneering Firm Sequential Consistency Measure
For Firms that Began As Followers

DV= Market Share	Data Test for 1988 MS (n= 148)		Data Test for 1991 MS (n= 228)	
	Block 1	Block 2	Block 1	Block 2
Intercept	0.01***	0.01	0.01***	0.01
Price Premium Firm#	-0.05	-0.05	0.02	0.01
Initial Rank Entry#	-0.24**	-0.19	-0.22***	-0.21
Sequential Consistency #		0.13		0.05
F	4.34**	3.67	5.79**	4.00
R^2	0.06	0.07	0.05	0.05
Std. Error of Estimate	0.01	0.01	0.01	0.01

#= Standardized Coefficients
One-tailed test:
* p < .05
** p < .01
*** p < .001

5.3 Hazard Rate Hypotheses Results

The second part to answering our research question as to the influence of consistent timing strategy on firm performance analyzes the impact on such strategies on a firm's survival rate. As such, the next set of hypotheses to be tested are:

H3a: Leaders that repeat as leaders will realize lower hazard rates than those leaders that switch to follower patterns during incremental technological changes.

H3b: Followers that repeat as followers will realize lower hazard rates than those followers that switch to leader patterns during incremental technological changes.

H3c: Leaders that repeat as leaders will realize higher hazard rates than those leaders that switch to follower patterns when faced with architectural changes.

H3d: Followers that repeat as followers will realize lower hazard rates than those followers that switch to leader patterns when faced with architectural changes.

To test these hypotheses, we examine firm hazard rate. Hazard rate can be viewed as a measure of risk associated with the inclusion of certain variables. Thus, higher hazard rates are associated with more risks and fewer firm survivals. As in our market share analysis, our independent variable in the testing of these hypotheses is our five measures of firm consistent entry timing. Control variables include firm pricing strategy, an indicator variable for firms with a lack of multi-cycled change experience, an indicator variable for leader follower, and the initial firm entry ranking. For our hazard estimations, we divided the full sample into two distinct groups: those firms that did not enter the laptop cycle and those firms that did enter the laptop cycles. Statistical significance is tested as a one-tailed test at the 0.05 level. To support our hypotheses, we would expect to find that our consistent timing measure will be negatively related to hazard rate along with a significant leader/follower indicator statistic.

Results of our Cox hazard models are included in Tables 5.59 through 5.63, each representing a different entry timing consistency measure. Model 1 for each calculation represents the inclusion of our control and indicator variables, while model 2 tests our timing consistency independent variable. For firms that did not enter the laptop cycle, thus remaining in the incremental cycles, we find that the control variable initial rank entry was the strongest association to firm hazard. Thus, later rank entry by a firm in its initial cycle adds to the hazard rate. We also find that the inclusion of the timing consistency measure in every case except rank entry added a significant value to our -2 log-likelihood (LL) measure: with the lowest contribution (6.56) significant at the 0.01 level. Specifically, we find that firm consistency in timing patterns reduce the hazard of firms competing in the incremental cycles by 2 percent (1-0.98) at our most pessimistic calculation and by 49 percent (1-0.51) in our most optimist calculation. The average reduction in hazard rate over all our consistency measure is 30.2 percent (1-0.698). Therefore, we can state that entry consistency does reduce the hazard associated with competing in the incremental PC cycles.

For firms that did enter the laptop cycle, we once again see a strong increased hazard associated with later initial rank entry. Further, in all but the rank consistency measure, lack of engagement in multiple cycles was also found in increase hazard rate. This suggests that a lack of prior switching experience, even through incremental cycle changes, makes switching to the new architectural cycle increasingly difficult. Most interesting is the results of our leader/follower indicator variable. We see strong evidence that leaders that make the switch to the laptop cycle experience an average 81.67 (1- 0.1833) percent decrease in hazard rate. This is most surprising and runs counter to our hypothesis. Our finding suggests that either leader firms are more adapt at new technologies, that the laptop cycle is not as disruptive as we thought, or that previous successes enjoyed by our leaders have lead to larger financial capabilities and our data does not extend out far enough to measure firm exits. We do, however, find once again that our measures of entry timing consistency are associated with a decrease in hazard rates for firms. On average, timing consistency results in a 48 (1- 0.52) percent decrease in hazard rate for firms entering the laptop cycle. Again, this is counter to what we had previously predicted, in that the reduction in hazard rate associated with consistent entry timing is greater in firms facing architectural change (48 percent) versus those facing incremental change (30.2 percent). This suggests that sticking to your knitting is vital when facing disruptive technological changes (Peters and Waterman, 1982).

Table 5.59
Test of Hypotheses 3a-3d
Cox Hazard Regression
LF Sequential Consistency

	Full Sample of Firms				Firms Not Entering Laptop Cycle *A test of Hypothesis 3a & 3b*				Firms Entering Laptop Cycle *A test of Hypothesis 3c & 3d*			
DV= Hazard Rate	**Model 1**		**Model 2**		**Model 1**		**Model 2**		**Model 1**		**Model 2**	
	b	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*
Price Premium Firm	0.06	1.06	0.04	1.04	0.07	1.07	0.07	1.07	0.02	1.02	-0.02	0.98
Non Multi-Cycled Firm	0.14	1.15	0.17	1.18	0.11	1.12	0.06	1.06	0.56	1.75	1.71^{**}	5.53
LF Firm	-0.31	0.73	-0.17	0.84	-0.02	0.98	0.13	1.13	-1.38^{*}	0.25	-1.26	0.28
Initial Rank Entry	0.02^{***}	1.02	0.02^{***}	1.02	0.02^{***}	1.02	0.02^{***}	1.02	0.02^{***}	1.02	0.02^{***}	1.02
Sequential Consistency			-0.86^{***}	0.42			-0.68^{**}	0.51			-1.41^{***}	0.24
Sample Size	359		359		262		262		97		97	
-2 Log-likelihood	1862.05		1844.17		1059.23		1052.67		506.46		494.15	
Δ (LL) with Consistency Measure	351.12^{***}		17.88^{***}		256.71^{***}		6.56^{**}		98.76^{***}		12.31^{***}	
Overall Chi-square	389.50		396.71		285.19		287.89		105.20		111.71	

One-Tailed Test:

* p < .05

** p < .01

*** p < .001

Categorical Recoding: Multi-Cycled Firm

0= compete in 3 or more cycles

1= competed in fewer than 3 cycles

LF Firm

0= follower

1=leader

Table 5.60
Test of Hypotheses 3a-3d
Cox Hazard Regression
Rank Entry Sequential Consistency

	Full Sample of Firms				Firms Not Entering Laptop Cycle *A test of Hypothesis 3a & 3b*				Firms Entering Laptop Cycle *A test of Hypothesis 3c & 3d*			
DV= Hazard Rate	**Model 1**		**Model 2**		**Model 1**		**Model 2**		**Model 1**		**Model 2**	
	b	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*
Price Premium Firm	0.06	1.06	0.06	1.06	0.07	1.07	0.05	1.05	0.02	1.02	0.02	1.02
Non Multi-Cycled Firm	0.14	1.15	0.14	1.15	0.11	1.12	0.23	1.25	0.56	1.75	0.87	2.39
LF Firm	-0.31	0.73	-0.32	0.72	-0.02	0.98	-0.14	0.87	-1.38^{*}	0.25	-1.35^{*}	0.26
Initial Rank Entry	0.02^{***}	1.02	0.02	1.02	0.02^{***}	1.02	0.02	1.02	0.02^{***}	1.02	0.02^{***}	1.02
Sequential Consistency			0.00	1.00			0.00	1.00			0.00	1.00
Sample Size	359		359		262		262		97		97	
-2 Log-likelihood	1862.05		1862.01		1059.23		1057.32		506.46		505.64	
Δ (LL) with Consistency Measure	351.12^{***}		0.04		256.71^{***}		1.91		98.76^{***}		0.82	
Overall Chi-square	389.50		394.83		285.19		290.18		105.20		105.56	

One-Tailed Test:

* p < .05

** p < .01

*** p < .001

Categorical Recoding: Multi-Cycled Firm

0= compete in 3 or more cycles

1= competed in fewer than 3 cycles

LF Firm

0= follower

1=leader

Table 5.61
Test of Hypotheses 3a-3d
Cox Hazard Regression
Z Score Entry Sequential Consistency

	Full Sample of Firms				Firms Not Entering Laptop Cycle *A test of Hypothesis 3a & 3b*				Firms Entering Laptop Cycle *A test of Hypothesis 3c & 3d*			
DV= Hazard Rate	**Model 1**		**Model 2**		**Model 1**		**Model 2**		**Model 1**		**Model 2**	
	b	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*
Price Premium Firm	0.06	1.06	0.05	1.05	0.07	1.07	0.06	1.06	0.02	1.02	-0.01	0.99
Non Multi-Cycled Firm	0.14	1.15	0.17	1.18	0.11	1.12	0.07	1.07	0.56	1.75	2.19^{***}	8.93
LF Firm	-0.31	0.73	-0.38	0.68	-0.02	0.98	0.12	1.12	-1.38^{*}	0.25	-2.03^{*}	0.13
Initial Rank Entry	0.02^{***}	1.02	0.02^{***}	1.02	0.02^{***}	1.02	0.02^{***}	1.02	0.02^{***}	1.02	0.02^{***}	1.02
Sequential Consistency			-0.56^{***}	0.57			-0.42^{**}	0.66			-1.08^{***}	0.34
Sample Size	359		359		262		262		97		97	
-2 Log-likelihood	1862.05		1835.39		1059.23		1050.94		506.46		485.16	
Δ (LL) with Consistency Measure	351.12^{***}		26.67^{***}		256.71^{***}		8.29^{**}		98.76^{***}		21.30^{***}	
Overall Chi-square	389.50		395.55		285.19		287.63		105.20		111.08	

One-Tailed Test:

* p < .05

** p < .01

*** p < .001

Categorical Recoding: Multi-Cycled Firm

0= compete in 3 or more cycles

1= competed in fewer than 3 cycles

LF Firm

0= follower

1=leader

Table 5.62
Test of Hypotheses 3a-3d
Cox Hazard Regression
Months from Pioneer Sequential Consistency

	Full Sample of Firms				**Firms Not Entering Laptop Cycle** *A test of Hypothesis 3a & 3b*				**Firms Entering Laptop Cycle** *A test of Hypothesis 3c & 3d*			
DV= Hazard Rate	**Model 1**		**Model 2**		**Model 1**		**Model 2**		**Model 1**		**Model 2**	
	b	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*
Price Premium Firm	0.06	1.06	0.06	1.06	0.07	1.07	0.09	1.09	0.02	1.02	-0.04	0.96
Non Multi-Cycled Firm	0.14	1.15	0.23	1.26	0.11	1.12	0.1	1.11	0.56	1.75	2.55^{***}	12.85
LF Firm	-0.31	0.73	-0.03^{***}	0.97	-0.02	0.98	0.48	1.61	-1.38^{*}	0.25	-1.44^{*}	0.24
Initial Rank Entry	0.02^{***}	1.02	0.02^{***}	1.02	0.02^{***}	1.02	0.03^{***}	1.03	0.02^{***}	1.02	0.02^{***}	1.02
Sequential Consistency			-0.03^{***}	0.97			-0.02^{***}	0.98			-0.05^{***}	0.95
Sample Size	359		359		262		262		97		97	
-2 Log-likelihood	1862.05		1834.55		1059.23		1048.94		506.46		482.22	
Δ (LL) with Consistency Measure	351.12^{***}		27.50^{***}		256.71^{***}		10.29^{***}		98.76^{***}		24.24^{***}	
Overall Chi-square	389.50		392.7		285.19		285.99		105.20		111.39	

One-Tailed Test:
* p < .05
** p < .01
*** p < .001

Categorical Recoding: Multi-Cycled Firm
0= compete in 3 or more cycles
1= competed in fewer than 3 cycles

LF Firm
0= follower
1=leader

Table 5.63
Test of Hypotheses 3a-3d
Cox Hazard Regression
Standardized Months from Pioneer Sequential Consistency

	Full Sample of Firms				**Firms Not Entering Laptop Cycle** *A test of Hypothesis 3a & 3b*				**Firms Entering Laptop Cycle** *A test of Hypothesis 3c & 3d*			
DV= Hazard Rate	**Model 1**		**Model 2**		**Model 1**		**Model 2**		**Model 1**		**Model 2**	
	b	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*	*b*	Exp *(b)*
Price Premium Firm	0.06	1.06	0.07	1.08	0.07	1.07	0.11	1.11	0.02	1.02	-0.01	0.99
Non Multi-Cycled Firm	0.14	1.15	0.05	1.05	0.11	1.12	-0.04	0.96	0.56	1.75	2.40^{***}	11.07
LF Firm	-0.31	0.73	-0.17	0.85	-0.02	0.98	0.33	1.39	-1.38^{*}	0.25	-1.75^{*}	0.18
Initial Rank Entry	0.02^{***}	1.02	0.02^{***}	1.02	0.02^{***}	1.02	0.02^{***}	1.02	0.02^{***}	1.02	0.02^{***}	1.02
Sequential Consistency			-0.29^{***}	0.75			-0.44^{**}	0.64			-0.59^{***}	0.55
Sample Size	359		359		262		262		97		97	
-2 Log-likelihood	1862.05		1848.74		1059.23		1051.52		506.46		493.82	
Δ (LL) with Consistency Measure	351.12^{***}		13.31^{***}		256.71^{***}		7.71^{**}		98.76^{***}		12.64^{***}	
Overall Chi-square	389.50		391.71		285.19		287.37		105.20		107.12	

One-Tailed Test:

* p < .05

** p < .01

*** p < .001

Categorical Recoding:

Multi-Cycled Firm
0= compete in 3 or more cycles
1= competed in fewer than 3 cycles

LF Firm
0= follower
1=leader

5.4 Summary of Results

Table 5.64.1 and 5.64.2 provides an overview of the results found for each hypothesis.

Table 5.64.1
Summary of Hypotheses Results

Hypothesis	Result	Findings
H1a	No Support Found	No support for the assertion that leaders will be leaders was found. More continuous measures of timing shows a negative relationship between repeated leadership entries in cases entering cycle 3.
H1b	Strong Support Found	Strong evidence was found indicating that previous follower behavior leads firms to become followers once again in times of incremental change. Support for this proposition was found in all but the dichotomous measure of entry timing.
H1c	No Support Found	Previous leader behavior was not found to be more difficult in times of architectural change. Nor was evidence found to indicate that leaders were able to be leaders again during these times.
H1d	Weak Support Found	Followers were found to be able to be followers again during architectural changes in our standardized number of months behind the pioneer measure. However, since this was not replicated in the other continuous measures of timing, further testing is needed to affirm this result.

Table 5.64.2
Summary of Hypotheses Results

H2a	No Support Found	No support was found to indicate that continuous leadership entry will lead to increased market share as measured at either the cycle or firm level.
H2b	No Support Found	No support was found to indicate that continuous followership entry will lead to increased market share. Further, we found evidence, when measuring entry timing as rank entry and as a z score of rank entry, of continuous rank entry timing having a negative relationship on market share.
H2c	Modest Support Found	A negative relationship between continuous leadership timing patterns when facing architectural innovations at the firm level was found. This relationship was present at the dichotomous, ranking, and z score measures of continuous entry timing.
H2d	No Support Found	No support was found for our contention that follower consistency will lead to higher market share when faced with architectural changes. In fact, we found a negative relationship when measuring entry timing as rank entry and as a z score of rank entry.
H3a	Weak Support Found	Support was found to indicate that leaders who repeated as leaders decreased their hazard rate when faced with an incremental technological cycle change.
H3b	Weak Support Found	Weak support was found to indicate that followers who repeated as followers decreased their hazard rate when faced with an incremental technological cycle change.
H3c	No Support Found	No support was found to indicate that leadership consistency will lead to a higher hazard rate when faced with an architectural technological change.
H3d	Support Found	Support was found to indicate that consistent follower entry timing lead to lower hazard rates when faced with architectural changes.

Figure 5.1 provides a graphical representation of the results found in this study.

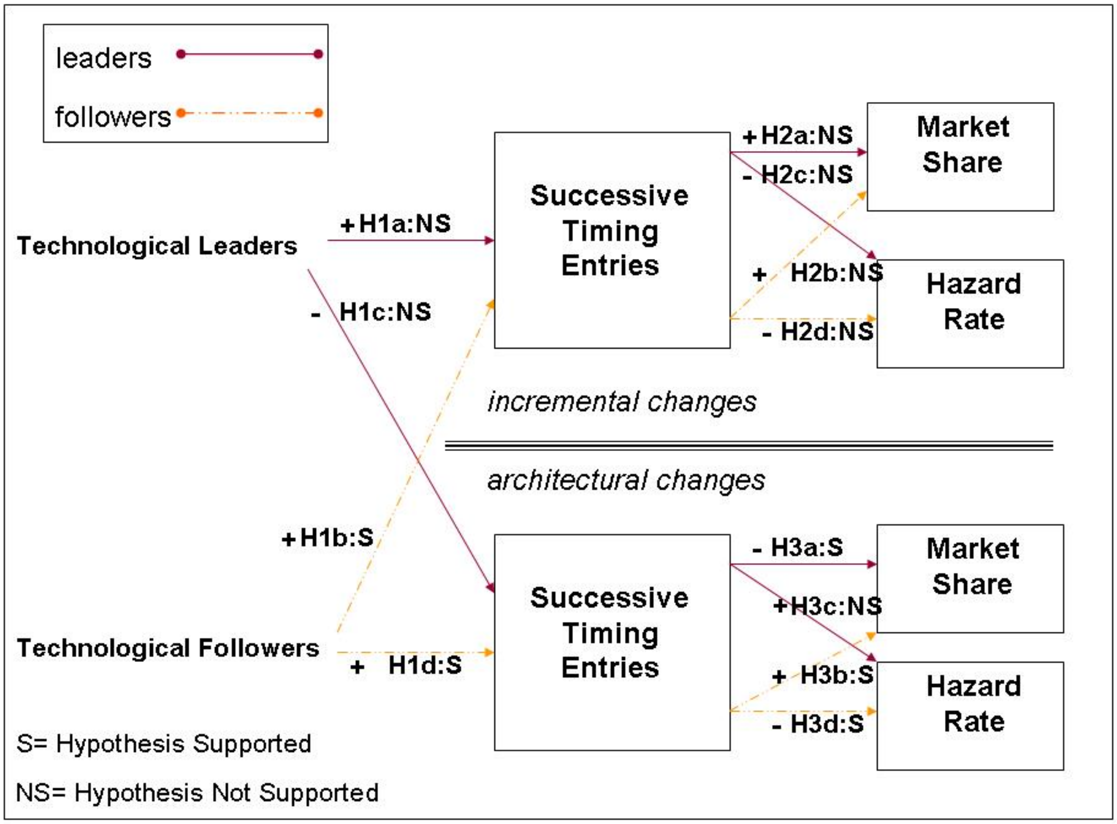


Figure 5.1: Summary Model of Hypotheses Results

6.0 CONCLUSIONS

The purpose of this study is to determine whether or not firms engage in consistent timing patterns, and the impact of these actions on long term firm performance. Conclusions of the research study are first presented in this chapter. Once these conclusions are presented, the limitations of the study are discussed, followed by the study's contribution to researchers, contribution to practitioners, and finally directions for future research.

Through careful analysis of the results obtained from the testing of our hypotheses, the following conclusions can be made:

Timing Consistency: Past literature informs us that the skill sets necessary to be successful as a leader are not the same as those required for followership excellence (Porter, 1985; Utterback & Abernathy, 1975). As a result, firm resource development and acquirement will differ depending on the timing strategy chosen by the firm. Over time, firm investments in a consistent set of capabilities built around a specific timing pattern will enable the firm to excel at the activities for which those capabilities are designed. Possessing finite resources, firm investments in one type of resources comes at a cost of resources that could be used at other times. Therefore, leaders are suggested to be leaders and followers are suggested to be followers when faced with incremental technological changes.

Architectural changes pose unique challenges for leaders. Specifically, the product creation and development skills honed over time in past incremental cycles may be unsuited to the new product architectural linkages created during architectural changes. Even if the leader firm is capable of understanding and eventually adjusting to a new set of component linkages, the time required to make these adjustments will force the leader to enter later in technological cycle, thus entering as followers and not leaders. With this in mind, we would expect leaders to be unable to be leaders again during these disruptive times. For the follower, the manufacturing and marketing skills developed through incremental cycles may allow for an easier transition into an architectural cycle.

The results of this study indicate that leaders have a difficult time repeating as leaders. Only four firms were able to enter three separate technological cycles as leaders. Twenty-four firms were able to lead two times. Further, three of the four firms that were able to lead in three cycles also produced laptops: an architectural cycle change. These repeat leaders differ in that they were more likely to be larger firms that charged a premium for their products: suggesting value added from the customer's perspective. Repeat leaders were also more likely to be diversified in their product offering.

Followers, conversely, were much more likely to be followers again. For followers, it did not seem to matter whether they were facing incremental or architectural changes, though the data suggests that fewer leader firms repeated in the laptop cycle within the timeframe of the dataset employed for this study.

The findings suggest that different theories must be applied to understand the actions of leaders and followers. For successful leader firms, the key seems to be investment in new technological cycles, coupled with strong capabilities in marketing and management. These findings suggest that these repeat leaders are in the possession of dynamic capabilities: those engrained skill sets capable of meeting the needs of dynamic environmental requirements (Teece, Pisano, & Shuen, 1997; Tripsas, 1997).

There also seems to be a liability of newness associated with firms in this study. Leaders that succeeded in becoming leaders again participated in more cycles, including the laptop cycle. While this may seem self-evident, their success over multiple cycles may suggest an increasing ability to identify new cycles and understand what must be done in order to succeed.

Theory implications for followers is more straightforward. Rather than the learning school, the building of resources and the resource-based view of the firm is more applicable. Followers are builders of manufacturing and marketing skills, skills that serve them well in multiple cycles: whether incremental or architectural. However, followers are less likely to be able to switch to leadership positions. This suggests the follower skill sets may be rigid, leaving them incapable of change (Leonard-Barton, 1992).

Market Share: We predicted that consistent entry timing would lead to increased market share during incremental cycle changes. The rationale is that targeted deployment of resources leads to the honing of skill sets and further investments based on past successes. Follower manufacturing and marketing skills are more easily adapted to architectural changes than are leader product skills, as it is the basic product component skills and understandings that are being challenged during these change periods. Therefore, we would expect the timing leader's market share to be negatively impacted by architectural changes while the timing follower's market share remains constant.

This study indicates that consistency does not generally impact market share. These findings echo the findings of a study by Robinson and Fornell (1985) who suggested that it is not entry timing, but rather the cost of production, cost of advertising, brand loyalty, quality, and other firm characteristics that lead to market share differences. It also reinforces the findings of Lambkin (1988) who suggested that order of entry is not as important as structure and strategy. Interestingly, market share of consistent leaders was found to be negatively impacted during architectural changes. This gives credence to the works of Henderson and Clark (1990) in that architectural changes negatively impact incumbent firms. More research is needed to determine why this relationship was found for this relationship and not the others tested.

Hazard Rate: Similar to the proposed relationships provided for the market share hypotheses, consistent entry timing by firms during times of incremental technology changes will lead to lower hazard rates. Also, we would expect the hazard rate of followers to not increase as it would for leaders when experiencing architectural changes. Therefore, we would expect to see increased hazard rates for leaders when facing these dramatic changes, while followers will see decreased market share.

This study finds that timing consistency reduces firm hazard. These findings differ from the findings of our market share hypotheses and suggests that market share may not be useful as a sole criterion when evaluating firm performance over time. Theorists from the resource-based view of the firm may suggest that consistent firm timing indicates management commitment to invest in the unique resources needed for a chosen stratgy. This resource consistency, in turn, reduces firm hazard rates.

Interestingly, leadership consistency appears to decrease firm hazard during architectural changes. While these findings counter the relationship suggested, they may reflect the research of Klepper and Simons (2000) in that larger firms with more resources to investigate new innovations and more relevant research and development experience will have lower hazard rates than smaller firms with fewer resources, and thus less flexibility. The building of innovation experience was also suggested by Schoonhoven and Jelinek (1990) and Lawless and Anderson (1996) to lead to firm survival. As our qualitative analysis found, most of the repeat leaders in our data set were larger, more diversified firms. These findings suggest that Eisenhardt & Martin's (2000) directive for firms to build "simple, structured, experiential, and iterative (not linear) routines and processes to meet changing environmental demands" (p. 1115) may be the best advice for the survival of leader firms.

6.1 Limitations

While much was learned from this study, there were limitations. Changes in the reporting and recording practices of the PC industry have limited the data available for this study. While multiple incremental and an architectural changes were able to be analyzed, the study could benefit from data detailing the results since 1991. For example, many of our previous leaders did make it into the laptop cycle, though a lack of data precluded our ability to follow them to their final destiny. It may be that timing into architectural cycles is not as important as simply choosing the cycle to enter; however, we cannot make that claim with the data used here. By continuing the data forward, we may find that the full effects of the laptop computer cycle had not yet been formed. Therefore, the results, or at times lack of results, found within this project may have been skewed. Obtaining what would more closely approximate a full technological lifetime of data would improve the validity our results.

Further, this study could benefit by extending the scope of architectural changes to the PC industry. In particular, the inclusion of new innovations such as Personal Data Assistants, Tablet PCs, and Gaming stations would allow us to chart and follow firms as they cross “industry” lines, as many firms have ventured into ancillary directions. The inclusion of these potential successor technologies would allow for a more accurate reflection of the total competitive actions made by firms regarding the numerous joint research and product launching efforts made by firms.

Frameworks are extremely useful in helping bounded minds understand their world within set conditions. In this light, this study could have allowed for more stratified timing choices. For example, Gort and Klepper (1982) identified five possible entry points, Utterback and Abernathy (1975) detail that firms may pursue three different entry strategies: one in which the firm attempts to be the first with new technologies (a performance-maximizing strategy); one in which the firm waits for innovations then quickly responds to those variations (a sales maximizing strategy); and finally a strategy in which the firm enters later in the product life cycle (a cost minimizing strategy). By including and testing more timing frameworks developed previously, we could determine which heuristics are worth saving and which may not be as valid.

Finally, this research project only provides a cursory qualitative examination of the characteristics possessed by repeated industry leaders. With more extensive qualitative research, a clearer picture as to why firms were unable to repeat as industry leaders over multiple cycles may be uncovered.

6.2 Contribution to Researchers

This study provides many useful contributions to researchers which should not only inform, but help guide future research efforts. First, our findings suggest that it is more likely for followers to remain consistent in their timing efforts than it is for leaders. However, several leaders were found to be able to lead in several cycles. Further, it was determined that timing consistency leads to a reduction in firm hazard rates. These results bolster the claims of not only the resource-based view of the firm, but the learning school as well. More work should be conducted to examine the dynamic capabilities of these successful leader firms so that more prescriptive accounts can be made to practitioners. Research should also be conducted to determine the outcomes, other than survival, of consistent followership. Perhaps timing consistency is more a direct contributor to internal strategic goals such as quality or innovation: which in turn lead to measurable performance improvements such as market share or profitability.

Second, the findings suggest that not all firms are susceptible to rigidities associated with resource building. Several of the firms studied here were able to lead during some cycles, and compete effectively as followers in others. This suggests dynamic resources, and an ability to learn and grow as an organization. More insight into these firms can be garnered through further integrating of diverse research streams.

Also, our findings suggest researchers may need to extend their notion of technological architectural changes to reflect not only changes in technological artifacts, but changes in technological structures. The IBM PC architecture may have been more than many leader firms could handle, as previous relationship established along the value chain may have lost value. Engaging in more alliances, diversifying risks instead of isolating firms, may have aided more firms in their quest to survive. Further study is needed.

This research effort also provides researchers with proof of the value of integrative research. In particular, instead of narrowing the focus of this investigation into the confines of one philosophical approach, such as the resource-based view of the firm, this research project used multiple sources to help interpret the information that was uncovered.

This study also makes several contributions to research methods. First, this study challenges established frameworks and notions of categorization. Specifically, we find that the operationalization of the timing variable is extremely important to obtaining valid, reliable measures of entry timing. We recommend that previous and future studies examine timing by using, at a minimum, ordinal variable measures. While this paper focused on the testing of entry timing, other frameworks should also continuously be challenged: as the outcomes derived from poor measures may lead both researchers and practitioners astray in their search for answers to the questions of the day.

While we were not able to make strong statements regarding the impact of technological timing onto market share, our findings clearly show that entry timing consistency is extremely important to survival. The differences in these findings suggest that researchers may want to test long term impact of strategic actions on both variables to ensure that best practices leads to long term firm survival. Market share and survival are not interchangeable firm outcomes.

Finally, this research project shows the value of not relying solely on quantitative research methods. Instead, in order to glean information regarding the small number of firms that were able to repeat as technological timing leaders, qualitative works were added to the investigation to test the hypotheses made. While more research must be conducted to confirm the propositions derived from the initial investigation made here, it is my belief that qualitative methods may hold the key to answering questions regarding many of the nuances encountered in management research. A specific example is the firm Eltech Research. Only through web search was it possible to discover that it left its position as a leader in the PC industry for the chemical engineering of fuel cells and batteries. If limited to one industry, we ignore the true competitive actions taken by firms. This is crucial in times such as these, when firms diversify more and more.

6.3 Contribution to Practitioners

The results of this research project have important implications for both business practitioners and society at large. For practitioners, the realization that consistency in entry timing practices can lead to lower hazard rates can make them more aware of the environmental conditions they should seek for their firm. For example, leader firms will want to make investments that deepen their capabilities in basic research and the ability to translate these ideas into commercially viable products. Further, leader firms must be made aware of the risks associated with such a chosen strategy. To succeed, they must be aware of the actions that allowed the select few to succeed, and how those practices may be incorporated into their firms. For follower firms, they must invest in manufacturing and marketing competencies, and look for emerging product markets ripe for market and economy building.

Through better knowledge of successful practice, society at large will also benefit. As firms are better able to use their resources, and make wise investments into future activities, the productivity frontier, representing the best practices of firms, will be pushed further outward (Porter, 1996).

6.4 Directions for Future Research

This research is but an early step towards our understanding of the interactions of firm resource building, resource implementation, and resulting performance. First, there is room to dig deeper into our understanding of how firm timing affects performance: in the current industry of study and others. A limitation of the data used for the testing of the hypotheses made here is that complete data ended in 1991. As such, the entire impact of the entry of laptops may not have been recognized. By gathering more data to supplement this data set we can see if there were any more long term effects caused by the disruptive technology.

Further, a more thorough examination of internal mediators between consistent entry timing and firm performance should be made. Fershtman, Mahajan, Muller (1990) suggest that entry order has no relevance to market share-rather it has impact on production costs, advertising costs, and price elasticity, which leads to quality, distribution, and line breadth. A future study may investigate timing entry in the personal computer industry utilizing these findings. We may find that timing is more important to the achievement of internal strategic goals which, in turn, lead to successful performance outcomes.

More data would also be useful to learn more about the repeated leaders of the PC industry. While qualitative data was gathered for this study, more needs to be conducted. Specifically, interviews with key top executives could shed light on the actions these PC firms took to stand out among the hundreds of firms that competed in the industry. These interviews could also shed light onto the networks and alliances made by firms during these early years of industry formation.

Also, there are opportunities to examine our definition of a technological cycle. While this study followed precedence and identified each processor change as an incremental cycle, our results may have been different if cycles were grouped differently. For example, switching from an 8/8 to a 16/8 cycle may not have posed the same obstacles as moving from a 16/8 to a 16/6 processor speed. Deeper study regarding the technical aspects of cycle evolution may yield more information regarding the impact of firm timing entry and performance implications.

This study was focused on the successive timing activities of firms. As such, many firms that entered as leaders initially, but that did not enter another cycle, were ignored. Also ignored were firms that entered into just one cycle as a follower. Just as concerned as we were in this study with firms that switched cycles, perhaps there are questions that could be answered regarding the firms that instead choose to ride down the trajectory of one curve. Were the profits of the no n-switchers equal to those that did not? Was the non-switcher hazard rate higher? While the answers to these questions may sound academic, perhaps there is a reason so many firms did not switch.

Another area of further study is the growing number of potential successor technologies challenging the PC industry. Many of the firms in this study were found to be involved in different levels of diversification. To learn more about how these diversification efforts have affected timing, if at all, we could cross industry lines and study the network effects firms may be pursuing through diversifying into technologies such as Personal Digital Assistants and new cellular phones.

While this study focuses on the PC industry, a dynamic, turbulent environment, we are unsure if the results obtained here can be applied to other industry types. By replicating this study onto other slower or moderate speed cycles, we can test the generalizability of the results found in this study.

7.0 BIBLIOGRAPHY

Abell, D. F. (1978). Strategic windows. *Journal of Marketing 42,* 21-26.

Abernathy, W. J. (1978). *The Productivity Dilemma.* Baltimore: The John Hopkins University Press.

Abernathy, W. J., Clark, K. B., & Kantrow, A. M. (1983). *Industrial Renaissance: Producing a Competitive Future for America*. New York: Basic Books, 1983.

Abernathy, W. J., & Utterback, J. M. (1978). Patterns of industrial innovation. *Technology Review, 80*(*7*), 40-47.

Afuah, A. (1998). *Innovation Management: Strategies, Implementation and Profits*. New York: Oxford University Press.

Afuah, A. (2001). Dynamic boundaries of the firm: Are firms better off being vertically integrated in the face of technological change? *Academy of Management Journal, 44(6),* 1211-1228.

Ali, A. (1994). Pioneering versus incremental innovation: Review and research propositions. *Journal of Production and Innovation Management 11*, 46-61.

Amburgey, T. L., Kelly, D., & Barnett, W. P. (1993). Resetting the clock - the dynamics of organizational-change and failure. *Administrative Science Quarterly, 38(1)*, 51-73.

Anderson, P. (1995). Microcomputer Manufacturers. In G.R. Caroll and M.T. Hannan (Eds.), *Organizations in Industry: Strategy, Structure & Selection.* Oxford: Oxford University Press, 37-58.

Anderson, P., & Tushman, M. L. (1990). Technological discontinuities and dominant designs - a cyclical model of technological-change. *Administrative Science Quarterly, 35(4*), 604-633.

Anderson, P., & Tushman, M. L. (1991). Managing through cycles of technological-change. *Research-Technology Management, 34(3)*, 26-31.

Argyris, C., & Schon, D. A. (1978). *Organizational Learning: A Theory of Action Perspective*. Reading, Massachusetts: Addison-Wesley.

Arthur, B. (1987). Competing technologies: An overview. In G. Dosi (ed.) *Technical Change and Economic Theory,* pp. 590-607. New York: Columbia University Press.

Baldwin, C. & Clark, K. (1997). Managing in an age of modularity. *Harvard Business Review, 75(5),* 84-93.

Barnard, C. I. (1938). *Functions of the Executive*. Cambridge, Massachusetts: Harvard University Press.

Barnett, W. P. (1990). The organizational ecology of a technological system. *Administrative Science Quarterly, 35(1),* 31-60.

Barnett, W.P. (1995). Telephone companies. In G.R. Caroll and M.T. Hannan (Eds.) *Organizations in industry: Strategy, Structure & Selection.* Oxford: Oxford University Press, 277-289.

Barnett, W. P., & Burgelman, R. A. (1996). Evolutionary perspectives on strategy. *Strategic Management Journal, 17*, 5-19.

Barney, J. B. (1986). Strategic factor markets - expectations, luck, and business strategy. *Management Science, 32(10)*, 1230-1241.

Barney, J. B. (1991). Firm resources and sustained competitive advantage. *Journal Of Management, 17(1)*, 99-120.

Barney, J. B. (2001). Is the resource-based "view" a useful perspective for strategic management research? Yes. *Academy Of Management Review, 26(1)*, 41-56.

Baum, J. A. C., & Rao, H. (1998). Strategic management as a fish-scale multiscience. In J. A. C. Baum (Ed.), *Disciplinary Roots of Strategic Management: Advances in Strategic Management, vol 15, 1998 (Vol. 15, pp. 332).* Stamford: JAI Press Inc.

Berry, W. D. (1993). Understanding regression assumptions. Series: Quantitative Applications in the Social Sciences, p. 92. Thousand Oaks, California: Sage Publications.

Bower, J. L., & Christensen, C. M. (1995). Disruptive technologies - catching the wave. *Harvard Business Review, 73(1)*, 43-53.

Braybrooke, D., & Lindblom, C. E. (1963). *A Strategy of Decision; Policy Evaluation as a Social Process*. New York: Free Press of Glencoe.

Bright, A. A. (1949). *The Electric Lamp Industry*. New York: Macmillan.

Bright, J. R. (1958). *Automation and Management*. Boston: Graduate School of Business Administration, Harvard University.

Burgelman, R. A. (1983). Corporate Entrepreneurship and Strategic Management: Insights from a Process Study. *Management Science, 29(12), 1349-1364.*

Burgelman, R. A. (1994). Fading memories - a process theory of strategic business exit in dynamic environments. *Administrative Science Quarterly, 39(1)*, 24-56.

Burgelman, R. A., & Grove, A. (1996). Strategic Dissonance. *California Management Review, 38(2), 8-28.*

Burns, T. & Stalker, G. M. (1961). *The Management of Innovation.* London: Tavistock Publications.

Buzzell, R. D., & Gale, B. T. (1987). *The PIMS principles: Linking Strategy to Performance.* New York: The Free Press.

Carroll, G. R., Bigelow, L. S., Seidel, MD. L., Tsai, L. B. (1996). The fates of de novo and de alio producers in the American automobile industry 1885-1981. *Strategic Management Journal, 17 (Special Issue: Evolutionary Perspectives on Strategy)*, 117-137.

Carroll, G. R., & Hannan, M. T. (1989). Density delay in the evolution of organizational populations: A model and five empirical tests. *Administrative Science Quarterly, 34(3),* 411-430.

Chandler, A.D. (1962). *Strategy and Structure: Chapters in the History of the American Industrial Enterprise.* Cambridge, Massachusetts: The M.I.T. Press.

Chandler, A. D. (1990). The enduring logic of industrial success. *Harvard Business Review, 68(2)*, 130-140.

Child, J. (1972). “Organization structure, environment, and performance: The role of strategic choice.” *Sociology*, 6, 2-22.

Christensen, C. M. (1992). Exploring the limits of the technology s-curve. Part i: Component technologies; part ii: Architectural technologies. *Production and Operations Management, 4*, 334-366.

Christensen, C. M. (1997). *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. Boston: Harvard Business School Press.

Christensen, C. M., & Bower, J. L. (1996). Customer power, strategic investment, and the failure of leading firms. *Strategic Management Journal, 17(3)*, 197-218.

Christensen, C. M., & Rosenbloom, R. (1995). Explaining the attacker's advantage: technological paradigms, organizational dynamics and the value network. *Research Policy 24(2)*, 233-257.

Christensen, C. M., Suarez, F., & Utterback, J. (1998). Strategies for survival in fast changing industries. *Management Science, 44(12)*, S207-S220.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive-capacity - a new perspective on learning and innovation. *Administrative Science Quarterly, 35(1)*, 128-152.

Cox, D., & Oakes, D. (1984). Analysis of survival data. New York: Chapman and Hall.

Dess, G. G., & Beard, D. W. (1984). Dimensions of organizational task environments. *Administrative Science Quarterly, 29*, 52-73.

Dewar, R. D., & Dutton, J.E. (1986). The adoption of radical and incremental innovations: An empirical analysis. *Management Science 32(11),* 1422-1433.

Dosi, G. (1982). Technological paradigms and technological trajectories - a suggested interpretation of the determinants and directions of technical change. *Research Policy, 11(3)*, 147-162.

Dosi, G., Nelson, R. R., & Winter, S. G. (2000). *The Nature and Dynamics of Organizational Capabilities.* Oxford: Oxford University Press

Eisenhardt, K. M. (1989). Making fast strategic decisions in high-velocity environments. *Academy Of Management Journal, 32(3)*, 543-576.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: What are they? *Strategic Management Journal, 21(10-11)*, 1105-1121.

Eisenhardt, K. M., & Tabrizi, B. N. (1995). Accelerating adaptive processes - product innovation in the global computer industry. *Administrative Science Quarterly, 40(1)*, 84-110.

Fershtman, C., Mahajan, V., & Muller, E. (1990). Market share pioneering advantage: A theoretical approach. *Management Science, 36(8)*, 900-918.

Flamm, K. (1988). *Creating the Computer*. Washington, D.C.: The Brookings Institution.

Foster, R. N. (1986a). Timing technological transitions. In M. Horwitch (Ed.), *Technology in the Modern Corporation: A Strategic Perspective*. Pergamon Press, Inc.

Foster, S. (1986b). *The Attacker's Advantage*. New York: Summit Books.

Fredrickson, F. J., & Mitchell, T. R. Strategic decision processes: comprehensiveness and performance in an industry with an unstable environment. *Academy of Management Journal, 27(2),* 399-423.

Freeman, J. H., Carroll, G. R., & Hannan, M. T. (1983) The liability of newness: Age dependence in organizational death rates. *American Sociological Review, 48*, 692-710.

Galunic, D. C., & Eisenhardt, K. M. (1996). The evolution of intracorporate domains: Divisional charter losses in high-technology, multidivisional corporations. *Organization Science, 7(3)*, 255-282.

Galunic, D. C., & Eisenhardt, K. M. (2001). Architectural innovation and modular corporate forms. *Academy of Management Journal, 44(6)*, 1229-1249.

Galunic, D. C., & Rodan, S. (1998). Resource recombinations in the firm: Knowledge structures and the potential for Schumpeterian innovation. *Strategic Management Journal, 19(12)*, 1193-1201.

Gersick, C. J. G. (1991). Revolutionary change theories - a multilevel exploration of the punctuated equilibrium paradigm. *Academy Of Management Review, 16(1)*, 10-36.

Golder, P., & Tellis, G. (1993). Pioneer advantage: Marketing logic or marketing legend. *Journal of Marketing Research, 30,* 158-170.

Gookin, D. (2005). *Laptops for Dummies.* Indianapolis, Indiana: Wiley Publishing, Inc.

Gort, M., & Klepper, S. (1982). Time paths in the diffusion of product innovations. *The Economic Journal, 92(367)*, 630-653

Granneman, S. (2005). *Computer History 1968-Present*. Retrieved 4/12/2005 from the World Wide Web site: http://www.granneman.com/techinfo/background/history/.

Greenstein, S. M., & Wade, J. B. (1998). The product life cycle in the commercial mainframe computer market, 1968-1982. *The RAND Journal of Economics, 29(4)*, 772-789.

Hannan, M. T., & Freeman, J. (1989). *Organizational Ecology.* Cambridge, MA: Harvard University Press.

Havens, C., & Knapp, E. (1999). Easing into knowledge management. *Strategy and Leadership, 27(2), 4-9.*

Henderson, A. D. (1999). Firm strategy and age dependence: A contingent view of the liabilities of newness, adolescence, and obsolescence. *Administrative Science Quarterly, 44,* 281-314.

Henderson, R. M., & Clark, K. B. (1990). Architectural innovation - the reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly, 35(1)*, 9-30.

Henderson, R. M., & Cockburn, I. (1994). Measuring competence - exploring firm effects in pharmaceutical research. *Strategic Management Journal, 15*, 63-84.

Hrebiniak, L. G., & Joyce, W. F. (1985) Organizational adaptation: Strategic choice and environmental determinism. *Administrative Science Quarterly, 30(3)*, 336-349.

Ireland, R. D., & Hitt, M. A. (1997). "Strategy-as-story": Clarifications and enhancements to Barry and Elmes' arguments. *The Academy of Management Review, 22(4)*, 844-847.

Kalish, S., & Lilien, G. L. (1986). A market entry timing model for new technologies. *Management Science, 32(2),* 194-205.

Kalyanaram, G., Robinson, W.T., & Urban, G. L. (1995). Order of market entry: Established empirical generalizations, emerging empirical generalizations, and future research. *Marketing Science, 14(3),* G212-G221.

Kerin, R. A., Varadarajan, P. R., & Peterson, R. A. (1992). First-mover advantage: A synthesis, conceptual framework, and research propositions. *Journal of Marketing, 56(4), 33-52.*

Klein, B. H. (1977). *Dynamic Economics*. Cambridge, Massachusetts: Harvard University Press.

Klepper, S. (1996). Entry, exit, growth, and innovation over the product life cycle. *American Economic Review, 86(3)*, 562-583.

Klepper, S., & Graddy, E. (1990). The evolution of new industries and the determinants of market structure. *Rand Journal of Economics, 21(1)*, 27-44.

Klepper, S. & Simons, K. L. (1993). *Technological Change and Industry Shakeouts*. Mimeo: Carnegie Mellon University.

Klepper, S., & Simons, K. L. (2000). Dominance by birthright: Entry of prior radio producers and competitive ramifications in the U.S. television receiver industry. *Strategic Management Journal, 21*, 997-1016.

Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science, 3(3)*, 383-397.

Kraus, J. (1973). *An Economic Study of the U.S. Semiconductor Industry.* Ph.D. Dissertation, New School for Social Research.

Laborlawtalk.com. (2005). *Microprocessor*. Retrieved 4/12/2005 from the World Wide Web site: http://encyclopedia.laborlawtalk.com/microprocessor.

Lambkin, M. (1988). Order of entry and performance in new markets. *Strategic Management Journal, 9(Summer)*, 127-140.

Lambkin, M., & Day, G. (1989). Evolutionary processes in competitive markets: Beyond the product life cycle. *Journal of Marketing, 51(3)*, 4-20.

Lawless, M. W., & Anderson, P. C. (1996). Generational technological change: Effects of innovation and local rivalry on performance. *Academy of Management Journal, 39*(5), 1185-1217.

Leonard-Barton, D. (1988). Implementation as mutual adaptation of technology and organization. *Research Policy, 15(5)*, 251-267.

Leonard-Barton, D. (1992). Core capabilities and core rigidities - a paradox in managing new product development. *Strategic Management Journal, 13*, 111-125.

Lieberman, M. B., & Montgomery, D. B. (1988). 1st-mover advantages. *Strategic Management Journal, 9*, 41-58.

Lieberman, M. B., & Montgomery, D. B. (1998). First-mover (dis)advantages: Retrospective and link with the resource-based view. *Strategic Management Journal, 19(12)*, 1111-1125.

Lilien, G. L., & Yoon, E. (1990). Timing of competitive market entry. *Management Science, 36(5)*, 568-585.

Lindblom, C. E. (1959). The science of 'muddling through'. *Public Administration Review, 19*, 79-88.

Mansfield, E. (1985). How rapidly does new industrial technology leak out? *The Journal of Industrial Economics, 34,* 217-223.

March, J. (1991). Exploration and exploitation in organizational learning. *Organization Science, 2(1)*, 71-87.

McGahan, A. M., Argyres, N. S., & Baum, J. A. C. (2004). Context, technology and strategy: Forging new perspectives on the industry life cycle. In J. A. C. Baum & A. M. McGahan (Eds.), *Business strategy over the industry lifecycle: Advances in strategic management* (Vol. 21, pp. 270). Stamford: JAI Press, Inc.

Meeus, M. T. J., & Oerlemans, L. A. G. (2000). Firm behavior and innovation performance: An empirical exploration of the selection-adaptation debate. *Research Policy, 29,* 41-58.

Miller, A. (1988). A taxonomy of technological settings with related strategies and performance levels. *Strategic Management Journal, 9(3)*, 239-254.

Mintzberg, H., Ahlstrand, B., & Lampel, J. (1998). *Strategy Safari: A Guided Tour Through the Wilds of Strategic Management*. New York: Free Press.

Mitchell, W. (1989). Whether and when - probability and timing of incumbents entry into emerging industrial subfields. *Administrative Science Quarterly, 34*(2), 208-230.

Mitchell, W. (1991). Dual clocks - entry order influences on incumbent and newcomer market share and survival when specialized assets retain their value. *Strategic Management Journal, 12(2)*, 85-100.

Mitchell, W., & Singh, K. (1993). Death of the lethargic: Effects of expansion into new technical subfields on performance in a firm's base business. *Organization Science, 4(2),* 152-180.

Moore, G. A. (2001). *Crossing the chasm-and beyond.* In R. Burgelman, M. A. Maidique, & S. C. Wheelwright (Eds.), *Strategic Management of Technology and Innovation, 3rd Ed.,* pp. 265-282. McGraw-Hill Companies, Inc.

Moore, M. J., Boulding, W., & Goodstein, R. (1991). Pioneering and market share: Is entry time endogenous and does it matter? *Journal of Marketing Research*, 28, 97-104.

Nelson, R. R. (1991). Why do firms differ, and how does it matter? *Strategic Management Journal, Winter Special Issue*, 61-74.

Nelson, R. R., & Winter, S. G. (1982). *An Evolutionary Theory of Economic Change*. Cambridge, Massachusetts: Belknap Press.

Patterson, J. (2005). *A History of Computers During My Lifetime- The 1980s*. Retrieved 4/12/2005 from the World Wide Web site: http://www.pattosoft.com/au/jason/Articles/HistoryOfComputers/1980s.html.

Pedhazur, E. J., & Schmelkin, L. P. (1991). *Measurement, Design, and Analysis*. Hillsdale, New Jersey: Lawrence Erlbaum Associates, Publishers.

Penrose, E. T. (1958). *The Theory of the Growth of the Firm*. London: Macmillan.

Peteraf, M. A. 1993. The cornerstones of competitive advantage: A resource-based view. *Strategic Management Journal*, 14, 179-191.

Peters, T, J., & Waterman, R. H. (1982). *In Search of Excellence: Lessons from America's Best Run Companies.* New York: Harper and Row.

Porter, M. E. (1980). *Competitive Strategy.* New York: The Free Press.

Porter, M. E. (1985a). *Competitive Advantage*. New York: The Free Press.

Porter, M. E. (1985b). Technology and competitive advantage. *Journal of Business Strategy, 5(3)*, 60-78.

Prahalad, C. K., & Hamel, G. (1990). The core competence of the corporation. *Harvard Business Review, 68(3)*, 79-91.

Prusa, T. J., & Schmitz, J. A. (1991). Are new firms an important source of innovation? *Economic Letters 35(3)*, 339-342.

Prusa, T. J., & Schmitz, J. A. (1994). Can companies maintain their initial innovative thrust? A study of the PC software industry. *The Review of Economics and Statistics, 76(3)*, 523-540.

Quinn, J. B. (1980). *Strategies for Change: Logical Incrementalism*. Homewood, Illinois: Dow Jones-Irwin.

Robins, J. A. (2004). When does the age of data matter? Notes on the selection of data for strategy research. In D. J. Ketchen, & D. D. Bergh, (Eds.) *Research Methodology in Strategy and Management*, Volume 1, 251-271.

Robinson, W. T. (1988). Sources of market pioneering advantages: The case of industrial goods industries. *Journal of Marketing Research, 25,* 87-94.

Robinson, W. T., & Fornell, C. (1985). Sources of marketing pioneer advantages in consumer goods industries. *Journal of Marketing Research, 22*, 305-317.

Robinson, W. T., Fornell, C., & Sullivan, M. (1992). Are market pioneers intrinsically stronger than later entrants? *Strategic Management Journal, 13,* 609-624.

Robinson, W. T., Kalyanaram, G., & Urban, G. L. (1994). First-mover advantages from pioneering new markets: A survey of empirical evidence. *Review of Industrial Organization, 9,* 1-23.

Rogers, E. M. (1962). *Diffusion of innovations*. New York: The Free Press.

Romanelli, E., & Tushman, M. L. (1994). Organizational transformation as punctuated equilibrium: An empirical test. *Academy of Management Journal, 37*, 1141-1166.

Rosenberg, N. (1972). *Technology and American economic growth*. Armonk, New York: M.E. Sharpe.

Rosenbloom, R. S. (2000). Leadership, capabilities, and technological change: The transformation of NCR in the electronic era. *Strategic Management Journal, 21(10-11)*, 1083-1103.

Rothaermel, F. T. (2001). Incumbent's advantage through exploiting complementary assets via interfirm cooperation. *Strategic Management Journal, 22(6-7)*, 687-699.

Rumelt, R. P. (1982). Diversification strategy and profitability. *Strategic Management Journal, 3(4)*, 359-369.

Rumelt, R. P. (1991). How much does industry matter? *Strategic Management Journal, 12(3)*, 167-185.

Ryan, B., & Gross, N. C. (1943). The diffusion of hybrid seed corn in two Iowa communities. *Rural Sociology, 8(1)*, 15-24.

Sahal, D. (1981). *Patterns of Technological Innovations*. Reading, Massachusetts: Addison-Wesley.

Schmalensee, R. (1982). Product differentiation advantages of pioneering brands. *American Economic Review, 72*, 349-165.

Schmalensee, R. (1985). Do markets matter much? *American Economic Review, 75,* 341-351.

Schoonhoven, C. B., & Jelinek, M. (1990). Dynamic tension in innovative, high technology firms: Managing rapid technological change through organization structure. In M. A. Von Glinow & S. A. Mohrman (Eds.) *Managing Complexity in High Technology Organizations,* pp 90-118. New York: Oxford University Press.

Schumpeter, J. A. (1942). *Capitalism, socialism, and democracy*. New York: Harper.

Simon, H. A. (1997). *Administrative Behavior: A Study of Decision-Making Processes in Administrative Organizations* (4th Edition). New York: The Free Press.

StatSoft. *Survival/Failure Analysis*. Retrieved 5/9/2005 from the World Wide Web site: http://www.statsoft.com/textbook/stsurvan.html.

Stavins, J. (1995). Model entry and exit in a differentiated-product industry: The personal computer market. *The Review of Economics and Statistics, 77(4),* 571-584.

Steffens, J. (1994). *Newgames: Strategic competition in the PC revolution.* New York: Pergamon Press.

Suarez, F. F., & Utterback, J. M. (1995). Dominant designs and the survival of firms. *Strategic Management Journal, 16(6)*, 415-430.

Teece, D. J. (1986). Profiting from technological innovation - implications for integration, collaboration, licensing and public-policy. *Research Policy, 15(6)*, 285-305.

Teece, D. J., & Pisano, G. (1998) The dynamic capabilities of firms: An introduction. In G. Dosi, D. J. Teece and J. Chytry (Eds.) *Technology, Organization and Competitiveness: Respective on Industrial and Corporate Change.* Oxford: Oxford University Press, 193-214.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal, 18(7)*, 509-533.

Tegarden, L. F. (1992). *Firm's Diversity and Timing and Choice of New Product Technology Adoptions: A Resource-Efficiency Perspective*. University of Colorado at Boulder Dissertation. Ann Arbor, Michigan: UMI Dissertation Services.

Tegarden, L. F., Echols, A. E., & Hatfield, D. E. (2000). The value of patience and start-up firms: A re-examination of entry timing for emerging markets. *Entrepreneurship Theory and Practice, 24(4)*, 41-58.

Tegarden, L. F., Hatfield, D. E., & Echols, A. E. (1999). Doomed from the start: What is the value of selecting a future dominant design? *Strategic Management Journal, 20(6)*, 495-518.

Thomas, L. A. (1995). Brand capital and incumbent firms' positions in evolving markets. *Review of Economics and Statistics, 77(3)*, 522-534.

Thomas, L. A. (1996). Brand capital and entry order. *Journal of Economics and Management Strategy 5(1)*, 107-130.

Tilton, J. E. (1971). *International Diffusion of Technology: The Case of Semiconductors*. Washington, D.C.: The Brookings Institution.

Tripsas, M. (1997). Unraveling the process of creative destruction: Complementary assets and incumbent survival in the typesetter industry. *Strategic Management Journal, 18*, 119-142.

Tripsas, M., & Gavetti, G. (2000). Capabilities, cognition, and inertia: Evidence from digital imaging. *Strategic Management Journal, 21(10-11)*, 1147-1161.

Tushman, M. L., & Anderson, P. (1986). Technological discontinuities and organizational environments. *Administrative Science Quarterly, 31(3)*, 439-465.

Tushman, M. L., & Murmann, J. P. (1998). Dominant designs, technology cycles, and organizational outcomes. In *Research in Organizational Behavior, Vol. 20, 1998* (Vol. 20, pp. 231-266). Stamford: JAI Press, Inc.

Tushman, M. L. & O' Reilly, C. A. (1996). Ambidextrous organizations: Managing evolutionary and revolutionary change. *California Management Review, 38(4),* 8-30.

Tushman, M. L., & Rosenkopf, L. (1992). Organizational determinants of technological change: Toward a sociology of technological evolution. *Research in Organizational Behavior, 14*, 311-347.

Urban, G. L., Carter, T., Gaskin, S., & Mucha, Z. (1986). Market share rewards to pioneering brands: An empirical analysis and strategic implications. *Management Science, 32,* 645-659.

Utterback, J. M. (1994). *Mastering the Dynamics of Innovation*, Boston: Harvard Business School Press.

Utterback, J. M., & Abernathy, W. J. (1975). A dynamic model of process and product innovation. *Omega 3(6)*, 639-656.

Utterback, J. M., & Suarez, F. F. (1993). Innovation, competition, and industry structure. *Research Policy, 22(1)*, 1-21.

Van de Ven, A. H. (1986). Central problems in the management of innovation. *Management Science, 32*(5), 590-607.

Weick, K. E. (1979). *The social psychology of organizing*. Reading, Massachusetts: Addison Wesley.

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal, 5(2)*, 171-180.

White, S. (2004). *A Brief History of Computing- Microprocessors.* Retrieved 4/13/2005 from the World Wide Web site: http://www.ox.compsoc.net/~swhite/history/timeline-CPU.html.

Williamson, O. E. (1985). *The economic institutions of capitalism*. New York: The Free Press.

Winter, S. G. (2001). Satisficing and capability learning. *Strategic Management Journal, 21*, 981-996.

Zahra, S. A. (1996). Technology strategy and financial performance: Examining the moderating role of the firm's competitive environment. *Journal of Business Venturing, 11,* 189-219.

Zander, U., & Kogut, B. (1995). Knowledge and the speed of transfer and imitation of organizational capabilities: An empirical test. *Organization Science*, *6*, 76-92.

8.0 APPENDICES

Appendix A

PC Timeline[2]

- 1952 -Sperry Univac offered (first commercial computer).

- 1964 -IBM System/360 mainframe(first modular computer, partially open architecture).

- 1969 -Intel's 3101 (64 bit bipolar static random access memory (SRAM)) & the 1101 (256- bit MOS- metal oxide semiconductor-SRAM) offered.

- 1970 -Intel offers the 4004 (4-bit Calculator "CPU").

- 1971 -Intel 1103 (1 kilobit DRAM- Dynamic random access memory) released.

- 1972 -Atari founded by Bushnell (Pong inventor);
  -Texas Instruments introduces first chip with processor, input/output, and memory circuits;
  -Intel produces the 8008 (8-bit chip).

- 1973 -Intel 8080 (8-bit microprocessor) released;
  -Gary Kildall designs CPM(Control Program for Microcomputers) OS.

[2] Personal computer history compiled from the following sources: Anderson, 1995; Gookin, 2005; Granneman, 2005; Patterson, 2005; White, 2004.

- 1974 -Radio Electronics Magazine (July) provides schematic on building a computer with the Intel 8008 chip.

- 1975 -Micro Instrumentation and Telemetry Systems (MITS) (from model air hobby kit industry) sells $395 Altair computer kit based on Intel's 8080 microprocessor. Users have to use machine language- operating system was CPM;
  -Bill Gates creates BASIC (Beginner's All-Purpose Symbolic Instruction Code) for use with the Intel 8080 chip- Microsoft formed. Writes BASIC code for other processors as well (Mostek 6502; Zilog Z-80; Motorola 6800);
  -Kildall creates Digital Research- First client is IMSAI (2nd microcomputer manufacturer, the "8088" for business use).

- 1976 -Jobs and Wozniak create Apple computer using MOS Technology (Mostek or MOS) 6502 chip;
  -Warner communications takes over Atari;
  -Computerland (Millard) opens as a seller of PCs.

- 1977 -Jobs & Wozniak create first desktop (non-Intel chip). They leave slots in the machine to accommodate different microprocessor boards that may allow performance enhancements;
  -Commodore (microprocessor manufacturer) launches PET in 1977, used Mostek 6502 chip- bought MOS and successfully competed on low cost strategy;
  -Tandy TRS 80 Model 1 launched- uses Zilog Z-80 chip & proprietary OS (TRS-DOS)- large distribution system (7,000 Radio Shack stores).

- 1978 -Intel 8086 (16 bit processor- Based on CISC- Complex Instruction Set Computing) released;
  -Apple II introduced ($895) used proprietary APPLE DOS at first, later used BASIC; -Atari launches PC using Mostek 6502 chip;
  -Space Invaders released;
  -MicroChess first $1mil software seller (on Apple II & TRS 80);
  -Apple Writer (elementary word processing) offered.

- 1979 -Motorola 68000 (16 bit processor) released;
  -Apple picks Motorola chip;
  -Bricklin & Frankston (Software Arts) release VisiCalc (1st spreadsheet). Only Apple computers initially;
  -WordStar released (MicroPro) for CPM based Z-80 machines.

- 1980 -Apple, Radio Shack & Commodore have 2/3rds of PC market- each with own OS;
  -IBM decides to enter in PCs (open architecture decision for software & components);
  -Intel Project crush & 8088 (8 bit 8086) launched;
  -Texas instruments releases TI-99 (16 bit- could not compete on prices with Commodore at the low end) Abandoned PC industry by 1983;
  -HP introduces the HP85- proprietary design could not compete with the CP/M standard;
  -Microsoft Z-80 card released, could be used in Apple computer to run other software apps;
  -Apple III launched- tries to retain software production in-house; Large computer firms sold desktops (Digital Equipment Corp, IBM, NCR, NEC, Olivetti, Wang, Xerox) all over $10,000- could not compete.

- 1981 -With no copyright protection, Sorcim copies VisiCalc and launches SuperCalc- it is estimated that there are as many illegal copies of VisiCalc as there were sold copies.
  -IBM enters into PC business in August- using the Intel 8088 chip (16bit) with large memory (64k to 1 mil bytes possible- IBM kept it at 64 though). Intel's 8086 was a true 16 bit but was not backwards compatible with software using 8 bit- the 8088 moved data in 8 bit increments- so it was compatible. Outsourced manufacturing, Microsoft Disk OS (PC-DOS, IBM allowed MS to sell to others as MS-DOS), and Microsoft BASIC language. IBM also released details of the architecture, offered 5 expansion slots, encouraged independent software developers (eg VisiCalc, WordStar- sold at the same time as compute- though not bundled), open BUS (so cards meant for IBM could be used by others), and used retail distribution channels (Sears, Computerland). IBM did copyright the BIOS system (in/output);
  -Osborne portable personal computer sold bundled with software, Z-80 (CPM) based.

- 1982 -Intel releases the 80286.

- 1983 -Intel project checkmate launched to eliminate Motorola;
  -Compaq formed- created alternative to IBM BIOS and created a successful "clone." Becomes the fastest startup in American history;
  -Apple introduces the Lisa- Motorola 68000 chip, 32 bit processor, 16 bit in/output. At $10,000 it was deemed too expensive;
  -IBM releases the XT (10 MG fixed storage disk);
  -IBM & Clones created two groups- High premium priced (IBM XTs) & Low Priced (clones).

- 1984 -Intel 1 Megbit DRAM offered;
  -Apple successfully launches the Macintosh;
  -IBM releases PC AT with Intel 80286 (16bit, 5 times faster than 8088);
  -With the addition of the IBM AT (80286), three groups created: inexpensive PCs, middle-range XTs, and expensive ATs. Most entrants came in at one of two types: 8088 or 80286 compatibles. Rare to offer both;
  -IBMs BIOS reversed engineered and let lose- now all clones were 100% compatible.

- 1985 -Intel's 80386 (32 bit microprocessor) created - could not get DOS for it (needed DOS 5.0- not 4.0 which was for the 286- also no 32 bit applications).

- 1986 -Compaq leapfrogs PCs with more expensive 80386 processor. For the first time, it did not wait for IBM to be a first mover.

- 1987 -IBM formally announces the Personal System 2 (PS/2) using Intel's 32bit 80386. Used proprietary BUS (Micro Channel) so old expansion cards would not work. The clones could not match the performance of the new BUS. IBM & MS announced OS/2. OS/2 delayed trying to make it compatible with the 80286; 9 clones defined alternative to Micro channel (16 bit AT bus & EISA (extended industry standard architecture) which could accommodate both 16 & 32 bit cards). Opened up market to new entrants coming in under the 80386 technology;
  -Two new entrants emerged: those offering low-priced 8088 or 80286s, and those selling 80386s at the bottom of the price range. Innovation focus shifts from IBM to chip makers.

- 1989 -Intel releases 80486 and has i860 in production (RISC chip- should it compete against its X86?);
  -IBM and others immediately integrates the 486 into PCs since it is simply the next generation of chip;
  -New segmentation: Premium (80486), Mid Priced (80386) & Economy (80286); Many of the 486 machines sold as servers, for which reliability key- few new entrants; RISC microprocessor (Reduced Instruction Set Computing) emerges as threat to CISC- had been used in workstations(UNIX systems). Motorola markets its 88000 RISC processor. Intel decides to work on next generation X86 (Pentium & Pentium Pro) to minimize performance differences to RISC chips- thinking customers would not leave;

- 1990 -MS & IBM split. Windows 3.0 introduced.

APPENDIX B

Review of Constructs

Construct	Measures		Literature
Timing (IV)			
	Timing	(rank)	Lieberman & Montgomery (1998)
			Anderson (1995)
		(natural log)	Mitchell (1991)
		(categories)	Gort & Klepper (1982)
	Entry		Stavins (1995)
			Mitchell (1989)
	New Firms		Mitchell (1991)
			Mitchell (1989)
			Afuah (2001)
			Tegarden, Echols, Hatfield (2000)
	Incumbent Firms		Mitchell (1991)
			Afuah (2001)
			Tegarden, Echols, Hatfield (2000)
	Time to first product		Afuah (2001)
	Exit		A. Henderson (1999)
			Tushman & Anderson (1986)
			Stavins (1995)
	Early adopters (1st 4 firms)		Tushman & Anderson (1986)
	Pioneering Model (1st model)		Stavins (1995)
	Pioneering Firm (was once 1st)		Stavins (1995)
	Industry Sales Leaders (>= 3% market sh)		Mitchell (1989)

Expansion Effect	
Expand into new subfield	Mitchell & Singh (1993)
Firm Size (IV)	
Capitalization	Klepper & Simons (2000)
Installed base	Afuah (2001)
Specialized Asset Possession	Mitchell (1989)
Cannibalization	Greenstein & Wade (1998)
Previous Experience (IV)	
Entrant Market share year prior to entry	Mitchell (1991)
Multiple of single subfield	Mitchell (1989)
By previous mfg	Klepper & Simons (2000)
Alignment (IV)	
Entry Choice	Tegarden, Hatfield, Echols (1999)
	Anderson (1995)
Design Strategy	Tegarden, Hatfield, Echols (1999)
Firm Age (IV)	
# Years in industry	A. Henderson (1999)
	Stavins (1995)
	Mitchell (1991)
	Klepper & Simmons (2000)
Performance (DV)	
Survival (Cox Proportional Hazard)	Tegarden, Hatfield, Echols (1999)
	Tegarden, Echols, Hatfield (2000)
Longevity	Mitchell & Singh (1993)
	Carroll, Bigelow, Seidel, Tsai (1996)
	Mitchell (1991)
	Klepper & Simmons (2000)
Market Share (% of US PC Shipment)	Tegarden, Hatfield, Echols (1999)
(natural log)	Tegarden, Hatfield, Echols (1999)
	Klepper & Simmons (2000)

(dollar share)	Mitchell & Singh (1993)
	Mitchell (1991, SMJ)
(predicted/actual)	Lawless & Anderson (1996)
Gross Sales (Sales Growth)	A. Henderson (1999)
	Fredrickson & Mitchell (1984)
	Steffens (1994)
Gross Sales	Prusa & Schmitz (1994)
Failure Rate (Industry exits)	A. Henderson (1999)
	Hannan & Freeman (1989)
Industry Technical Performance (DV)	Afuah (2001)
Size (unit sales of industry)(C)	Anderson (1995)
	Suarez & Utterback (1995)
	Tegarden, Hatfield, Echols (1999)
	A. Henderson (1999)
Size (Firm Size) C (Log of deflated annual sales)	A. Henderson (1999)
	Mitchell (1989)
	Mitchell (1991)
	Mitchell & Singh (1993)
	Barnett (1990)
	Freeman, Carroll, Hannan (1983)
Industry Age (C)	Anderson & Tushman (1990, ASQ)
Past entry experience (C)	Mitchell (1989)
Entry Timing (C)	Tegarden, Hatfield, Echols (1999)
	Tegarden, Echols, Hatfield (2000)
Square of entry timing	Tegarden, Hatfield, Echols (1999)
Timing relative to DD	Suarez & Utterback (1995)
	Tegarden, Hatfield, Echols (1999)
Innovation Rate (process/product)	Klepper & Simmons (2000)
Firm Age (C)	Lawless & Anderson (1996)
Firm Average Price (C)	Tegarden, Hatfield, Echols (1999)

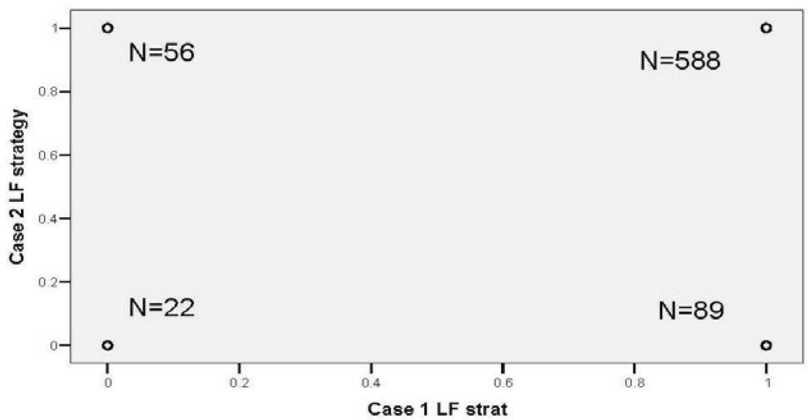
Start-up/Established (C)	Anderson & Tushman (1990)
Industry Demand (C)	Anderson (1995)
	Lawless & Anderson (1996)
Industry Growth (C)	Lawless & Anderson (1996)
	Mitchell (1991)
	Tegarden, Echols, Hatfield (2000)
	Tegarden, Hatfield, Echols (1999)
Industry Concentration (C)	Anderson (1995)
Industry Density C	Hannan & Freeman (1989)
	Carroll & Hannan (1989)
	Tegarden, Hatfield, Echols (1999)
	A. Henderson (1999)
	Stavins (1995)
	Tegarden, Echols, Hatfield (2000)
# models produced by firm in previous year (C)	Stavins (1995)
Founding Density (C)	Tegarden, Hatfield, Echols (1999)
	Tegarden, Echols, Hatfield (2000)
	A. Henderson (1999)
	Carroll & Hannan (1989)
Exit Density (C)	Tegarden, Hatfield, Echols (1999)
	Suarez & Utterback (1995)
Demand Uncertainty (C)	Anderson (1995)
	Tushman & Anderson (1986)
Community Size (C)	A. Henderson (1999)
Technological Change (price/perf/cycle time)	Tushman & Anderson (1986)
	Anderson & Tushman (1990)
Munificence	Tushman & Anderson (1986)
Growth	Lawless & Anderson (1996)
Generational Change	Lawless & Anderson (1996)
Relative Cohort Performance	Prusa & Schmitz (1994)

Appendix C

Scatterplots of Consistency Measures

Scatterplot of Entry Timing- All Firms

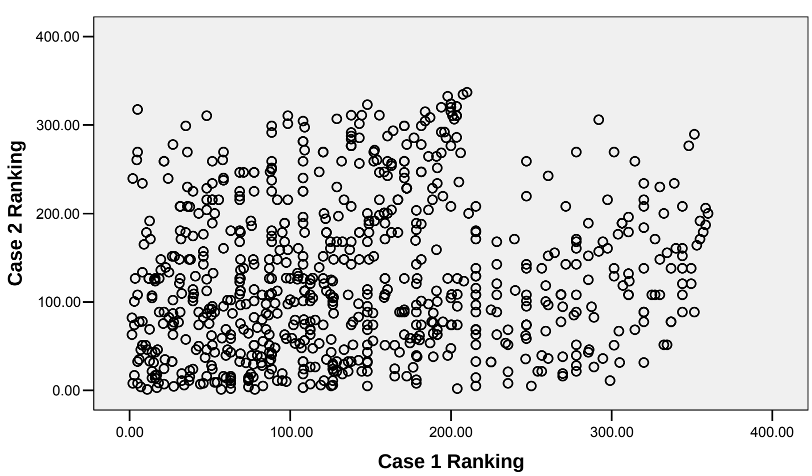
Categorical LF Method



N= 755

Scatterplot of Entry Timing- All Firms

Entry Ranking Method



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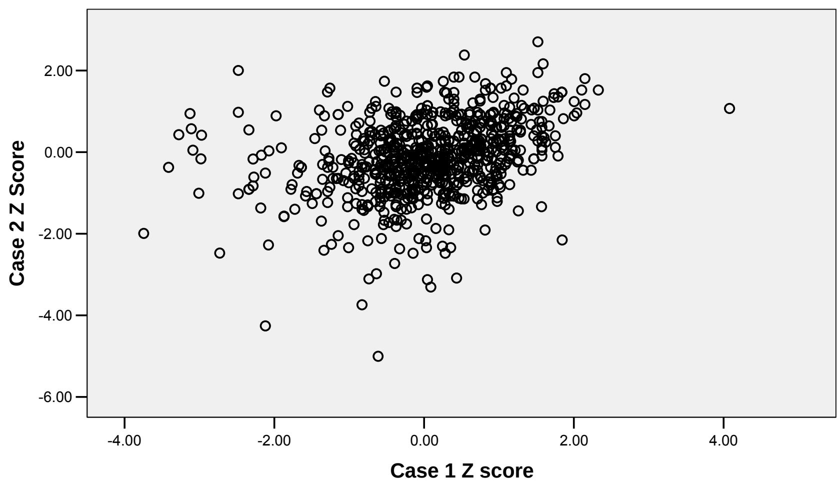
Scatterplot of Entry Timing- All Firms

Entry Ranking Z-Score Method



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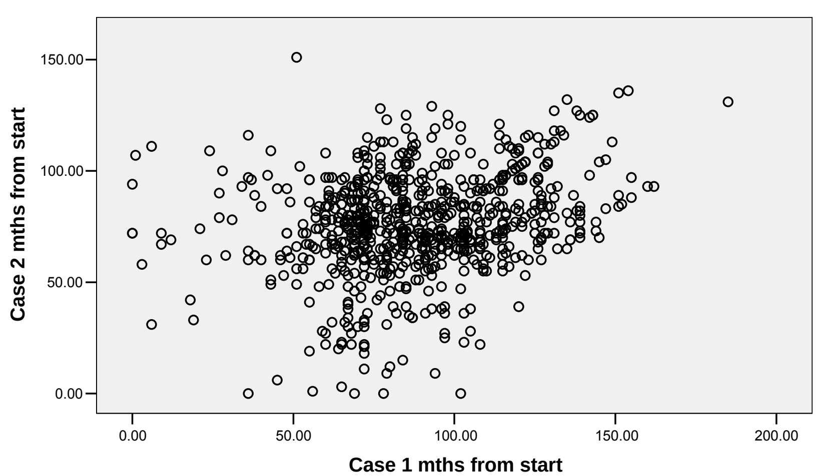
Scatterplot of Entry Timing- All Firms

Number of Months Behind Pioneer Method



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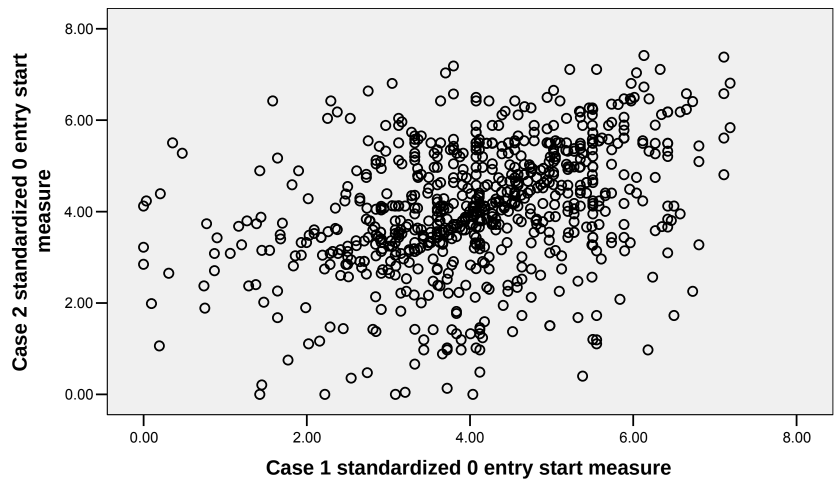
Scatterplot of Entry Timing- All Firms

Standardized Number of Months Behind Pioneer Method



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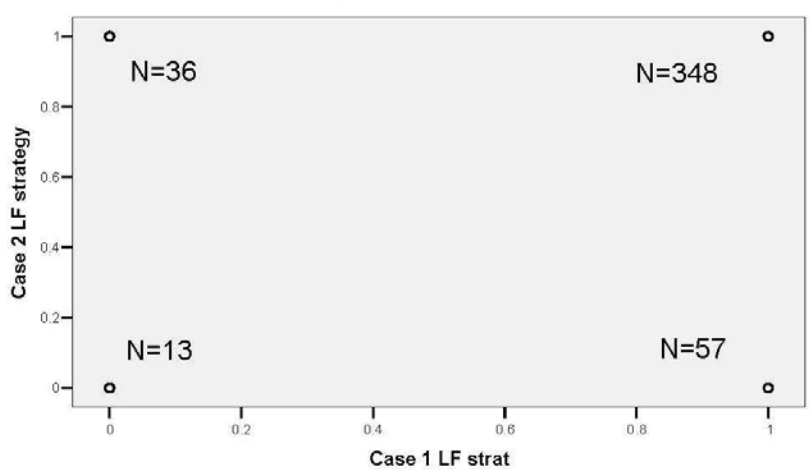
Scatterplot of Entry Timing- No Laptop Entry

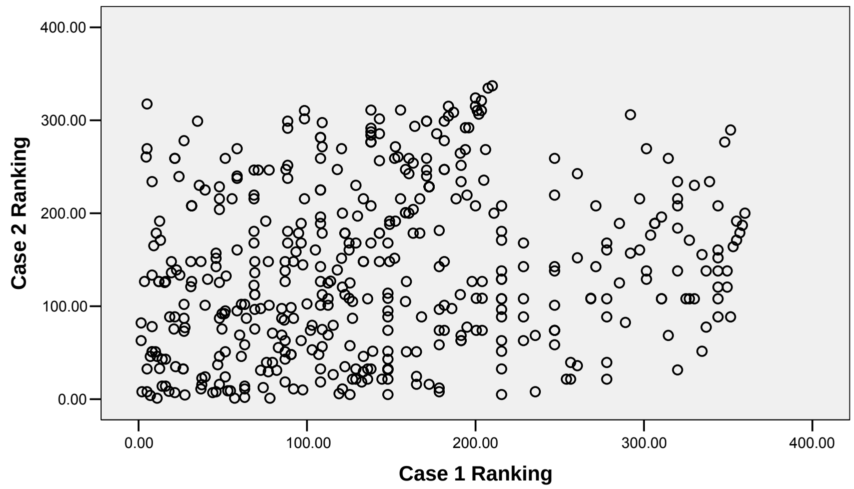
Categorical LF Method



N= 454

Scatterplot of Entry Timing- No Laptop Entry

Entry Ranking Method



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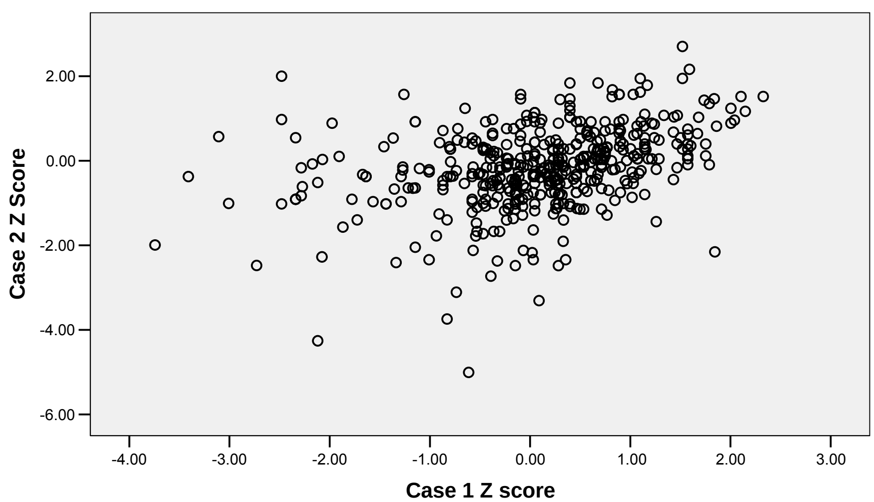
Scatterplot of Entry Timing- No Laptop Entry

Entry Ranking Z-Score Method



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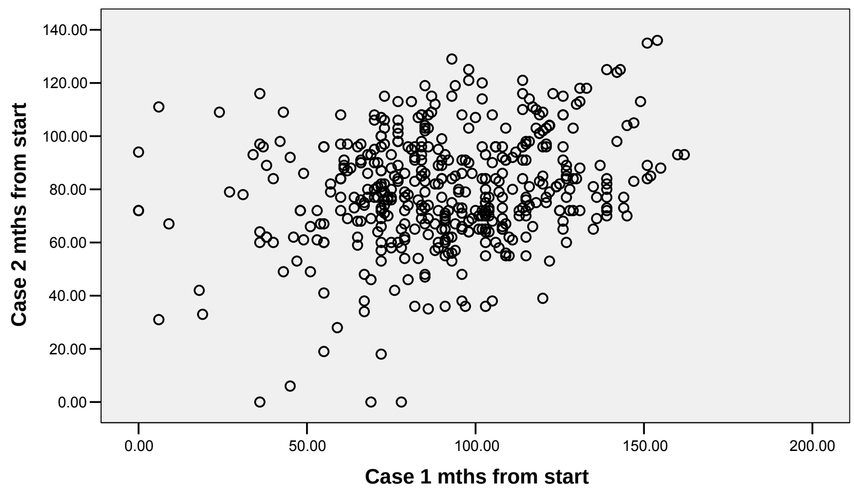
Scatterplot of Entry Timing- No Laptop Entry

Number of Months Behind Pioneer Method



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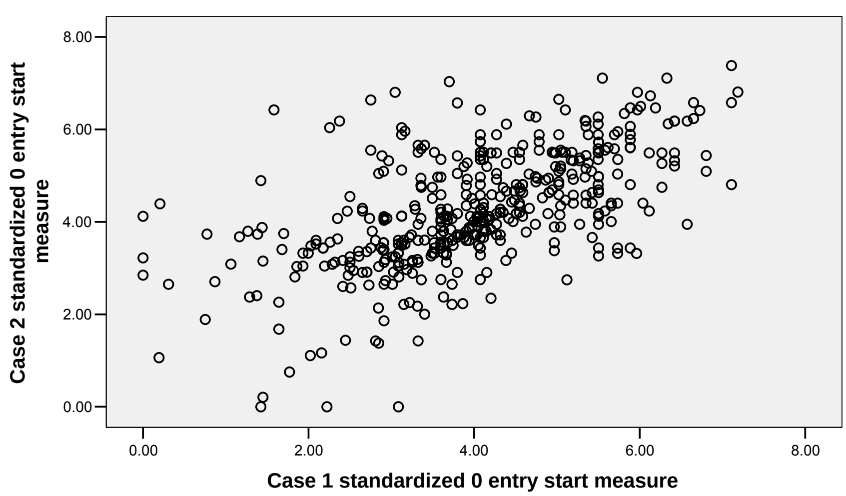
Scatterplot of Entry Timing- No Laptop Entry

Standardized Number of Months Behind Pioneer Method



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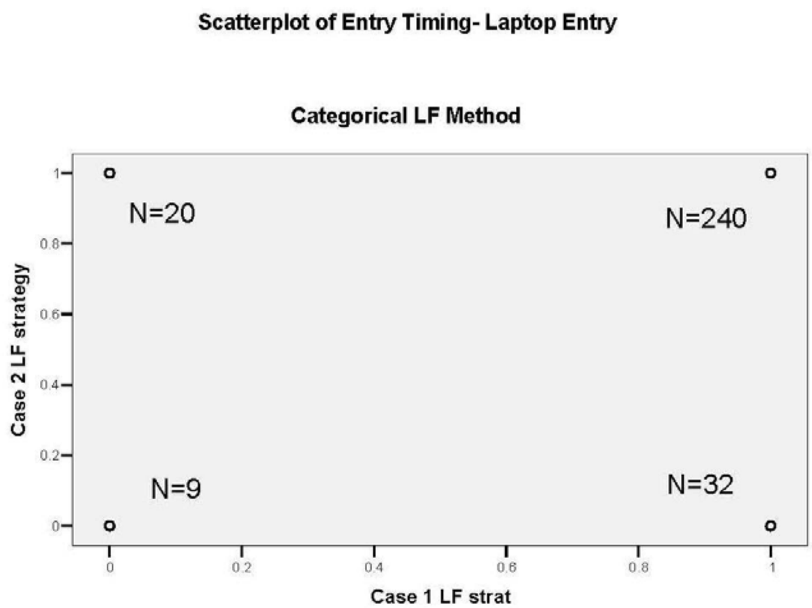
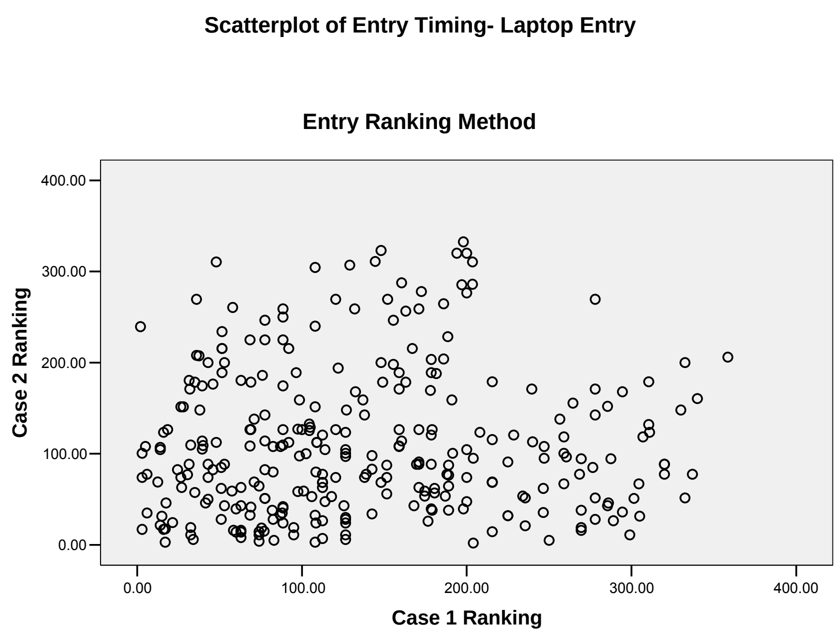

Scatterplot of Entry Timing- Laptop Entry
Categorical LF Method
N=20
N=240
N=9
N=32
Case 2 LF strategy
Case 1 LF strat
0
0.2
0.4
0.6
0.8
1

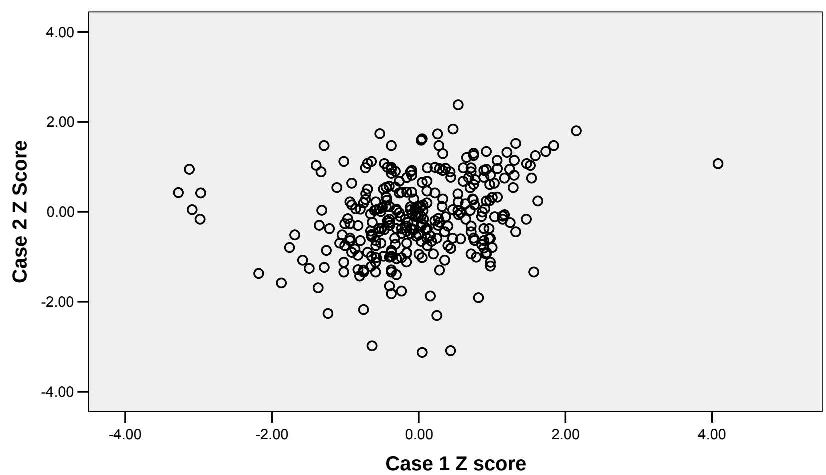
N= 301


Scatterplot of Entry Timing- Laptop Entry
Entry Ranking Method
Case 2 Ranking
Case 1 Ranking
0.00
100.00
200.00
300.00
400.00

N= 301

Scatterplot of Entry Timing- Laptop Entry

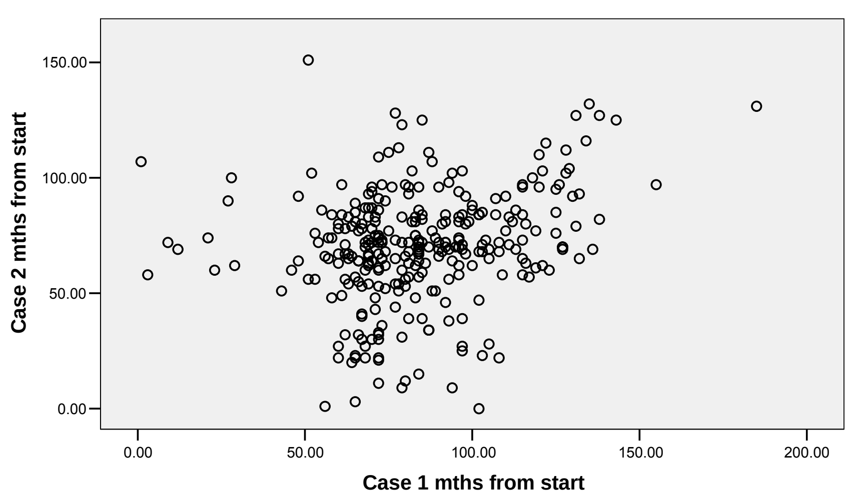
Entry Ranking Z-Score Method



N= 301

Scatterplot of Entry Timing- Laptop Entry

Number of Months Behind Pioneer Method



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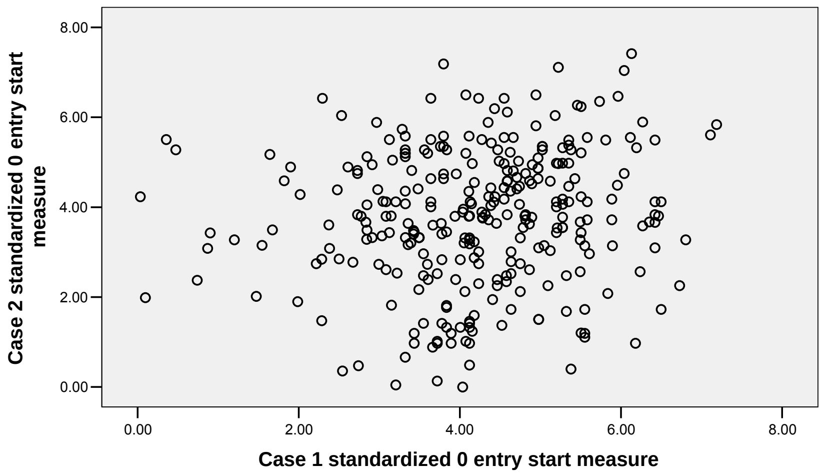
Scatterplot of Entry Timing- Laptop Entry

Standardized Number of Months Behind Pioneer Method



N= 301

Chapter 9: CURRICULM VITAE

John Stephen Childers, Jr.

John Stephen Childers, Jr. **Curriculum Vitae**

Department of Management and Marketing- Radford University
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Present Rank Assistant Professor, December 2005

Education

Doctorate of Philosophy. Concentration in Management: Strategic Studies
Virginia Polytechnic Institute and State University. *Blacksburg, Virginia*
Secondary Area: Social Issues Minor: Science and Technology Studies
-Litschert Memorial Fellowship for Outstanding Scholastic Achievement

Dissertation: "An Examination into Technological Timing Efforts:
The Performance of Firms in the Personal Computer Industry"
Committee Members: Donald E. Hatfield and Linda F. Tegarden (Co-Chairs), Phillip A. Gibbs, James R. Lang.

Master of Business Administration. Concentration in Health Care Administration
Bachelor of Science in Business Administration. Marketing Major
East Carolina University. *Greenville, North Carolina*

Teaching Experience

Assistant Professor: Radford University
Courses Taught Fall 2004- Fall 2005
Business Policy and Strategy, Starting and Managing a Small Business.

Instructor: Virginia Polytechnic Institute and State University
Courses Taught Fall 2000- Summer 2004
Business Policy, Management Leadership and Theory, E-Management.
- Virginia Tech GTA Commendation Award, 2003.
- Pamplin College of Business Graduate Student Teaching Award, 2003.
- Hoover Award, VT Department of Management Teaching Award, 2002.

Director, Small Business Institute/Instructor: East Carolina University
Courses Taught Fall 1993-Spring 2000:
Small Business Management, Small Business Counseling (Graduate Level), Human Resources Management, Fundamentals of Management, Management Science, Marketing Management.
- Four-time SBIDA National Finalist Undergraduate Case of the Year.

Advisor: Society for Advancement of Management (SAM) 1994-2000. Group placed second in the nation for the years 1997 and 2000 and third in the nation for the years 1995 and 1996. 2000 team won first place in the National Case Competition.
- SAM National Outstanding Advisor, 1996 and 2000.

Industry Experience

- S&T Machinery and Engineering: Prague, Czechoslovakia. Assisted in marketing and strategic management for the retail computer firm, 1992.
- Numerous formal and informal small business counseling performed through the ECU-Small Business Institute, 1989-1991 and 1995-2000.

Professional Certifications

Certified Small Business Counselor (CSBC)
Professional in Human Resources (PHR)

Original Works/Research

Articles- Peer Reviewed

Tegarden, L.F., Sarason, Y., Childers, J.S., & Hatfield, D.E. (2006). The engagement of employees in the strategy process and firm performance: The role of strategic goals and environment. *Journal of Business Strategies*, 22(2), (Forthcoming).

Childers, J.S., & Offstein, E. Building entrepreneurial e-commerce competitive advantage: a blending of theory and practice. *Advances in Competitiveness Research* (Forthcoming).

Childers, J.S., Offstein, E., & Geiger, B. (2004, October). Entrepreneurship and E-Commerce: Using Trust to Attain Competitive Advantage. *Competition Forum,* 2(1), 117-126.

Childers, J.S., Simerly, R.L. & Bass, K.E. (2002, March). Competitive environments and sustained economic rents: A theoretical examination of country- specific differences within the pharmaceutical industry. *International Journal of Management*, 19(1), 89-98.

Articles- Proceedings

Childers, J.S. & Geiger, B.D. (2002). "Trust as an asset: The use of trust by Internet firms as a source of competitive advantage." *International Association of Business & Society Proceedings*.

Geiger, B.D. & Childers, J.S. (2001). "Corporate philanthropy, social responsibility, and crises situations: An examination of possible motivations for corporate philanthropy in the aftermath of Hurricane Floyd." *International Association of Business & Society Proceedings*.

Presentations- Refereed

Childers, J.S., Tegarden, L., Sarason, Y., & Hatfield, D. *Strategy making and firm performance: The critical link of strategic goals- Moderated by environmental and organizational variables.* Presented at the 2003 Annual SMS Conference in Baltimore, MD.

Childers, J.S. & Geiger, B.D. *Trust as an asset: The use of trust by Internet firms as a source of competitive advantage.* Presented at the 2002 Annual International Association of Business & Society (IABS) Conference, Victoria BC, CA.

Tegarden, L., Hatfield, D., Childers, J.S., & Sarason, Y. (2002) *Strategic Goals as a Mediator of the Relationship Between Strategy-Making and Performance*. Presented for the Virginia Tech Management Department Research Series.

Geiger, B.D. & Childers, J.S. *Corporate philanthropy, social responsibility, and crises situations: An examination of possible motivations for corporate philanthropy in the aftermath of Hurricane Floyd.* Presented at the 2001 Annual IABS Conference, Sedona, AZ.

Other Publications

Contributor: How to Start a Business. Greenville/Pitt County Chamber of Commerce, 1999.

Presentation- Invited

"Human Resources: Finding, Hiring and Retaining Good Workers." 1997 NC Small Business Technology and Development Center Spring Professional Development Meeting. Sunset Beach, NC.

Conference Discussant

"HRM and the Joint Venture Type of Global Alliance." Loess, K. at the 1997 SAM International Conference in Las Vegas, NV.

"Marketing on the Internet: A Proactive Approach." Spiller, L. & R. Hamilton at the 1997 Small Business Institute Directors' Association (SBIDA) Convention in Orlando, FL.

"Improving Productivity Down Under: Exploring Australia's Best Practices Program." Spagnola, R. at the 1996 SAM Conference in Corpus Christi, TX.

Activities

Academic

- Member- Academy of Management.
- Member- Strategic Management Society.
- Member- International Association of Business & Society.
- Member- Radford University Faculty Club.
- Member- VT Management Graduate Curriculum Committee, Fall 2003.
- Selected- 2003 Academy of Management BPS Doctoral Consortium.
- Reviewer for Fundamentals of Management Textbook: Prentice Hall, 2003.
- ECU Management Curriculum Review Committee, Fall 1998-Spring 2000.
- Professional Paper Reviewer for 2000 USABE/SBIDA Conference.
- National Case Judge: 1997- 2000 SBIDA Graduate Case Competition.
- Won Writing Intensive status for the Small Business Management, Fall 1997.
- Professional Paper Reviewer for 1997 SBIDA Conference.
- National Case Judge: 1996 SBIDA Undergraduate Case Competition.
- Reviewer: Gomez-Mejia, Balkin & Cardy. Managing Human Resources: Prentice Hall, 1996.
- Software reviewer for the American Institute for Financial Research, 1996.
- Course Development: Small Business Institute graduate offering, Fall 1995.

Grants Administered

Davis Endowment Fund: ECU Small Business Institute, 1996-2000.
Small Business Administration for the ECU Small Business Institute, 1995.

Other Awards and Honors

- Phi Kappa Phi, national honor society, 2002.
- Omicron Delta Kappa, national honor leadership fraternity, 2001.
- Coleman Foundation Scholarship: 2000 USASBE/SBIDA Conference.
- Sigma Iota Epsilon, management honors fraternity, 1996.
- Mu Kappa Tau, marketing honors fraternity, 1992.