Complementary Resources' Role in First Movers and Followers in I.T. Industries

Gezinus J. Hidding, Ph.D., Associate Professor, School of Business Administration, Loyola University Chicago, 1 E Pearson St, Room 382, Chicago, IL 60611, phone: (312) 915-7059, fax: (312) 915-6231, ghiddin@luc.edu, http://orion.it.luc.edu/~ghiddin

Thomas Wilson, MBA, Vice President, Client Operations, AdReady, Inc., 936 N 34th St, 3rd floor, Seattle, WA 98103, phone: (563) 340-4400, fax: (206) 632-2685, twilson@adready.com.

Jeffrey R. Williams, Ph.D., Professor, Tepper School of Business, Carnegie Mellon University, Pittsburgh, PA, 15213, phone: (412) 268-3589, jrw@cmu.edu

Thomas Kuncheria, MBA, Associate, Booz & Co, 7 Savoy Court, Strand, London WC2R 0JP, UK, phone: +44 (0)20 7393 3355, fax: +44 (0)20 7393 0025 thomas.kuncheria@booz.com

Complementary Resources' Role in First Movers and Followers in I.T. Industries

Acknowledgements

We dedicate this paper to Mr. Sanjeev Rayu, who, having just completed data collection for this paper, and having just earned his MBA from Loyola University Chicago, sadly passed away. We acknowledge all the students who assisted in the initial data collection for this research. Last, but not least, we are grateful for the research support provided by Loyola University Chicago.

Biographies

Gezinus J. Hidding, Ph.D.

Gezinus Hidding, joined Loyola University Chicago in 1996, after a 10-year career with Andersen Consulting (now Accenture). He has authored over 20 refereed publications. Gezinus Hidding is funding the Aart Bosman prize, awarded by the University of Groningen, the Netherlands, for the best Ph.D. dissertation in Information Systems in the Netherlands and Belgium. He is Founder and CEO of You Rent It.com. He received his M.Sc. and Ph.D. in Information Systems from the Tepper School of Business of Carnegie Mellon University. He also received a B.Sc. and M.Sc. in Econometrics from the University of Groningen.

Jeffrey R. Williams, Ph.D.

Jeff Williams has authored 40 studies on business strategy, including works in The Journal of Law and Economics, The Journal of Economic Behavior and Organization, Fundamental Issues in Strategy, Industrial and Corporate Change, the Federal Trade Commission, the Sloan Foundation, and the National Science Foundation. He has received the California Management Review Pacific Telesis Award for best new thinking in management, and his clients have included IBM, AT&T, Bristol-Myers Squibb, National Semiconductor, Mellon Bank, McKinsey, United Technologies, Goodyear, Bell Labs, and Seagate Technologies.

Thomas Wilson

Thomas Wilson's experience has been in the online advertising industry – with both technology and marketing perspectives. Tom has worked extensively on developing customized third party ad serving and targeting solutions. Over the last 5 years, he has managed the successful execution of over $100 million dollars in online advertising. Tom earned a Masters Degree from the University of Iowa, and an MBA from Loyola University Chicago.

Thomas Kuncheria

Thomas earned his MBA from London Business School and a Masters degree in Information Systems Management from Loyola University Chicago and has previously worked with Deloitte consulting and Bearingpoint (formerly KPMG consulting) in North America.

Complementary Resources' Role in First Movers and Followers in I.T. Industries

Abstract

Research indicates that in various industries, including I.T.-driven industries, the market leaders were not first movers, but followers. Perhaps first movers are at a disadvantage when they have less complementary resources than followers do, as hypothesized by Teece (1987). To test that "complementary resources" hypothesis, data was collected on 25 I.T.-driven product categories. However, this study did not establish that complementary resources played a significant role for early entrants in determining market leadership. The paper presents implications of the findings and ideas for further research.

Keywords: Complementary resources, first-mover advantage, follower advantage, early entrant advantage, Information Technology, I.T. industries.

Complementary Resources' Role in First Movers and Followers in I.T. Industries

INTRODUCTION

It is commonly believed that being the first to enter a new market will provide advantages to the pioneering firm. These advantages are collectively called first-mover advantages, since the seminal paper by Lieberman and Montgomery (1988). Ten years later, Lieberman and Montgomery (1998) conclude that "potential advantages accruing to followers may be as important as those going to pioneers." Indeed, the frequently cited study of consumer products by Golder and Tellis (1993) found followers to be more successful than pioneers. For Information Technology (I.T.)-driven industries, Lieberman (2002) and Hidding and Williams (2005) also found that market leadership is often captured by followers. However, they did not study specific reasons for follower advantage. Given that I.T. is becoming ever more pervasive in modern economies, and that follower advantages in I.T.-driven product categories have not been studied extensively, we focused on the question of *why* followers win in I.T.-driven product categories. We studied a wide variety of I.T.-driven product categories, including hardware (e.g., routers by Cisco), software (Excel spreadsheets by Microsoft), enterprise software (SAP), information services (Google), and ecommerce (B2B auctions by Ariba, as well as B2C sites such as Amazon.com).

I.T.-driven product categories may be different from other product categories, for several reasons, see also (Hidding and Williams, 2005): Product life cycles are generally faster. I.T.-driven products exhibit network effects, where the value to the next customer depends on how many customers are using the product already (Shapiro and Varian, 1999), e.g., auctions (eBay) or operating systems (Windows). Many I.T.-driven products are not difficult to imitate (Teece,

1987). Similarly, the more I.T.-driven products critically rely on software, the lower the marginal costs are (Williams, 1998), possibly even zero absent a copyright fee (Shapiro and Varian, 1999). Some of these characteristics are preconditions of the "complementary resources hypothesis" formulated by Teece (1987), which posits that followers often become market leaders because they have more complementary resources at market entry than first movers did. Complementary resources are assets and skills that have limited ability to generate competitive advantage by themselves, but they can do so in combination with other resources. Generally, complementary resources include, e.g., a network of dealer servicing agents or management skills. For I.T.-driven product categories, complementary resources include product development capability (Microsoft), server farm capacity (Google), relations with key customers (SAP), marketing skills (IBM).

In this study, we studied the question: *Did first movers lose to followers that had more complementary resources?* We collected data for 25 I.T.-driven product categories. Our results indicated that the amount of complementary resources does not play a significant role in the competition for I.T. market leadership. We find these somewhat striking findings worthy of careful interpretation. For example, this suggests that established I.T.-based firms cannot count on preexisting complementary resources to gain market leadership. For example, Microsoft has not built market leadership in search engines, despite several complementary resources that would seem important in that market, e.g., technical skills and linkages with prior products, product development capabilities, and network effects. Conversely, startups' relative lack of complementary resources does not appear to preclude subsequent market leadership. For example, when eBay entered the market it had virtually no complementary resources. Since we share the reader's curiosity regarding the underlying mechanisms, we describe avenues for

further research in the final section.

LITERATURE REVIEW

Our literature review focused on hypotheses regarding follower advantage that have been empirically tested. We found four, namely about product innovation, timing of market entry, free rider effects, and asset leveraging, particularly of complementary resources. They have been tested in various industries, but not in I.T.-driven product categories.

Hypotheses regarding Follower Advantage

One hypothesis is that pioneers are overtaken by followers who are better at *product innovation*, for which Shankar et al. (1998) found support in the pharmaceutical industry. Lieberman and Montgomery (1988) proposed that the pioneer's own inertia might inhibit further innovation at a fast-enough pace. In I.T.-driven product categories, speed of innovation may well be relevant particularly when product life cycles are short (Williams, 1998). For example, search engines that brought early innovations (e.g., Webcrawler) were overtaken by others (Lycos), who were, in turn, overtaken by Google.

A second hypothesis regarding follower advantage that was also supported concerned *timing of market entry*. In another study of pharmaceutical products, Shankar et al. (1999) found that entering the market at the growth stage outweighs entering either the early or mature stages. Lieberman and Montgomery (1988) had pointed out that pioneers develop products around early technology standards that are replaced by later standards introduced by followers. For example, in online bookstores, early entrants such as Bookstacks Unlimited lost out, arguably because Amazon entered the market when the web started expanding rapidly.

A third hypothesis that has empirical support concerns *free-rider effects*, which found support in the pharmaceutical industry (Shankar *et al.*, 1999). In the microwave over industry,

Schnaars (1994) found that followers benefited from the pioneer's high cost of R&D. In the animation industry, Bryman (1997) found that followers were more likely to survive than pioneers were by luring workers away from the pioneer. In industrial markets, Bouldin and Christen (2001) found that pioneers gained significant sales advantages but incurred even larger cost disadvantages. In I.T. product categories, it is generally not difficult to create a functionally equivalent copy of earlier innovations (Williams, 1998). For example, Microsoft has generally been a follower, copying key features of pioneering products, such as the spreadsheet look and feel from Lotus 1-2-3.

A fourth hypothesis is that early followers overtake pioneers because of greater *asset leveraging*, particularly leveraging of financial resources. Lilien and Yoon (1990) analyzed data about industrial products from France to test whether followers are most successful when developing superior products supported by strong promotional spending and aggressive pricing. However, the data did not support their hypothesis. I.T. product categories exhibiting network effects often have low marginal costs, resulting in high cash flow (Shapiro and Varian, 1999). I.T. firms such as IBM and Cisco have leveraged their considerable financial assets.

Complementary Resource Hypothesis

A specific hypothesis regarding asset leveraging concerns complementary resources (Teece, 1987). Complementary resources are assets and skills that have limited ability to generate competitive advantage by themselves, but can do so in combination with other resources. Generally, complementary resources include, for example, a network of dealer servicing agents, established distribution networks, or management skills such as marketing. For I.T.-driven product categories, complementary resources include those mentioned earlier and also design skills (Apple), brick and mortar assets (Ahold), technical innovation skills (Google) and skills of

integrating acquired businesses (Cisco). Specifically, Teece (1987) wanted to "explain why a fast second or even a slow third [follower] might outperform the innovator." Teece defined the latter as "those firms that are first to commercialize a new product or process in the market," which we call "first movers" in this paper.

Teece (1987) proposed the "complementary resources hypothesis" that first movers lose to followers that possess specialized or co-specialized complementary resources, particularly if the services or products of the first mover are easy to imitate. We note Teece's assertion that it is often not difficult to develop a competing product that is technically different, but functionally equivalent. Generally speaking, I.T. is easy to imitate and legal protection is weak. Hence, Teece's complementary resources hypothesis seems particularly relevant for I.T.-driven product categories.

Teece distinguishes between generic, specialized and co-specialized complementary resources. Generic complementary resources are "general-purpose" resources that "do not need to be tailored to the innovation in question," e.g., capital. Specialized resources are those resources where either the innovation depends on the resource or the resource depends on the innovation, e.g., trucks to transport shipping containers. Co-specialized resources depend on the innovation and the innovation depends on the resource, e.g., shipping containers and shipping-port loading/unloading equipment. I.T. resources may be (co-)specialized. For example, Microsoft's Internet Explorer browser requires a Microsoft Windows Operating System. Also, Ahold leveraged its traditional distribution channels and marketing skills to move into online grocery delivery by buying Peapod. In I.T.-driven product categories, complementary resources are often generic and not very (co-)specialized.

The complementary resources hypothesis has been tested in several technology-intensive

industries, but not in I.T.-industries. In a study of the typesetter industry, Tripsas (1997) found that complementary resources could be leveraged by established firms to create a competitive advantage in new markets. In the biopharmaceutical industry, Rothaermel (2001) found that new biotech start-ups did not displace older incumbent firms, but that the established firms used their complementary resources to create alliances with innovators that had developed a new product. In the imaging industry, Mitchell (1989) found that, in some cases, firms would choose to be a follower based upon the relative strength of their specialized assets. In startups across five technology-intensive SIC codes, Gans et al. (2002) found that, in markets with strong intellectual property protection and specialized assets, the better strategy for innovators was to cooperate with incumbents. Conversely, in markets with lower importance of incumbents' complementary assets, the better strategy for innovators was to compete with incumbents.

Conclusion of Literature Review

Four major hypotheses regarding follower advantage, namely about product innovation, market timing, free rider effects, and asset leveraging, particularly of complementary resources, have been tested in various industries, but *not in I.T.-driven product categories*. The complementary resources hypothesis seems particularly relevant for I.T.-driven product categories, because the precondition that I.T.-based innovations are easy to copy is generally true.

RESEARCH QUESTIONS

In formulating the null-hypothesis of Teece's complementary resource hypothesis, we derived two possible negations: One is that first movers generally *win*, which, however, is not true generally, including for the I.T.-driven product categories we analyzed. The second negation is that first movers lose to followers with *less* complementary resources, which was to

be tested. Hence, we studied the question: *In I.T.-driven product categories, did first movers lose to followers that had more complementary resources?* This particular question follows Teece (1987) in focusing on followers versus first movers, not on followers versus other followers, which would have constituted a more general question. It is important to note that first movers are not necessarily young startup firms and that followers are not necessarily old established firms. Within any product category, the first mover may be an old established firm and followers can be young startups or established firms. Therefore, a follower may, or may not, possess more complementary resources than the first mover.

In the first phase of our study, we compared first movers and current leaders within I.T.-driven product categories. If complementary resources are important for followers in general, we expect them to be even more important for the follower who is overall market leader, i.e., the leader over all other firms in the product category.

Proposition 1: In I.T.-driven product categories, the first mover lost to a follower who is currently the overall market leader and who had more complementary resources at market entry than the first mover had at market entry.

In order to ensure we did not potentially bias the results by comparing the first mover only to the current leader within each I.T.-driven product category, we also compared the first mover to another follower that is currently not the overall market leader (Holland, 1986 and Singleton and Straits, 1999). We note Teece's focus on "fast second or even slow third" entrants. Since *early* entrants often become industry leaders, we compared the first mover to another follower that entered *before* the current leader did, and analyzed *relative* leadership. *Relative* market leadership within a pair means that, while neither firm may be leading the market overall, one firm is leading relative to the other firm. Comparing only early entrants might have biased the

sample if we had found support for the complementary resource hypothesis, which, however, we did not. Also, it might be argued that comparing first movers only to two other early entrants might not be sufficient. However, in the interest of parsimony and given the consistency in the results we obtained, we did not collect additional data.

Proposition 2: In I.T.-driven product categories, the first mover lost relative market leadership to a follower who is currently not the market leader but who had more complementary resources at market entry than the first mover had at market entry.

In order to benefit from as large a dataset as possible, we also compared first movers to followers regardless of whether the followers became overall market leaders or not. That is, specific pairs can include a firm with overall market leadership, in which case that firm also has relative leadership over the other firm.

Proposition 3: In I.T.-driven product categories, the first mover lost leadership, either overall or relative leadership, to a follower who had more complementary resources at market entry than the first mover had at market entry.

For all three propositions, the null hypothesis is that there is no statistically significant relationship between the amount of complementary resources at market entry of the first mover and followers and market leadership.

METHOD

Next, we describe our approach, the metrics we used, the sample data we collected about various I.T.-driven product categories, and the statistical tests used to analyze the data.

Approach

Consistent with Teece (1987), we determined who the "first several entrants" were to sell a product within each product category and the current market leader. In determining who the first

several entrants were, we wanted to avoid survivor bias, the sampling bias that includes firms that have survived and omits the early pioneers, including small and unknown ventures that did not survive (Lieberman and Montgomery, 1988). It is important to note that our sample, while minimizing survivor bias *within* I.T.-driven product categories, is still subject to survivor bias *of* the product categories, as we only focused on product categories that survived. Within this study, however, we could not test any extent of such bias.

Similar to seminal studies of consumer products (Golder and Tellis, 1993; Tellis and Golder, 1996), we sought to avoid survivor bias by following an approach known as historical analysis. To determine which firms entered when, we evaluated documents of the past, particularly those written around the same time when new products emerged, for example, articles in the business press with key content along the lines of "Last week, company A introduced a new product X." We gained access to such documents via online sources, such as Google and Factiva, and by tracing back references in printed materials such as books or magazines. We also consulted industry monographs describing the history of particular product categories and published case studies. Appendix A lists key references for various product categories.

To find current data (as of June 2006) about market leadership by still-active firms in I.T.-driven product categories, we used information in SEC 10K reports, reports from market research firms, and/or recent articles in the business press. SEC 10K reports are annual financial reports, audited by accounting firms, that publicly traded firms must file with the Securities and Exchange Commission (SEC) under US securities laws. Generally, 10K reports are considered authoritative reports about revenues, profits and the like.

Metrics

As argued above, an advantage of historical analysis is the reduction of survivor bias in the

sample. A disadvantage of historical analysis is that it is often difficult to find even basic data, e.g., which firm entered when. For example, even after several years of elapsed time, we still have not been able to determine who entered the router market first: Cisco or Proteon? Furthermore, it is often prohibitively difficult to find more-detailed data, e.g., members of the initial management team or revenues in early years, particularly when startups were small private companies. For example, for PriceWatch, a private firm providing web-based price comparison since 1995, we could not find even basic information such as the names of founders or initial executives and the firm did not respond to our requests for such information. Consequently, we could not gather more-detailed data regarding complementary resources.

As a result, we constructed two proxies that are general, simple, and different. The first proxy is *entry status* of each firm: "Startup" versus "established." The other metric is the firm's *age at market entry*. One of the simplest distinctions is whether a firm is a startup or an established firm. Hence, the first proxy we constructed is an ordinal zero-one variable we called "entry status."

criteria at market entry:

1. The firm sold other products before it entered the product category under study. If a firm sold other products before entering the new market in question, that firm must have had at least some complementary resources[1]. For example, Microsoft introduced Excel in 1985, but it had sold other software products before, e.g., the BASIC computer language.

2. The firm had acquired key technologies or key parts of another firm, e.g., a team of people or a division. If so, it effectively acquired complementary resources. For example, DoubleClick bought web-tracking software from Internet Advertising Network (IAN), which enabled

[1] *We could not distinguish systematically how "related" any previous products may have been and/or how co-specialized any complementary resources may have been with such previous products.*

DoubleClick to enter the product category of web advertising management software.

3. The firm was a spin-off from another firm. When a firm is a spin-off from a parent, it is endowed with resources from the parent. For example, several search engines such as Google, Yahoo, and Lycos, started as projects in universities, benefiting from the university's extensive complementary resources such as expertise, equipment, and relationships.

We defined a firm's "entry status" to be "startup" if it was not "established." The second proxy we constructed is the *age of each firm*, first mover or follower, at the time of market entry. The age of a spin-off at the time of the spin-off was defined to be the age of the parent company. Where the firm's age was dependent on the age of multiple firms, e.g., in a merger, we took the age to be the oldest of them. We did this because the spin-off or the merged firms could benefit from the resources that had been accumulated since the earliest days of its predecessors. Note that the "age at market entry" variable is a ratio-scaled, or continuous, variable.

These two proxies are related in that they rest on the assumption that an established, or older, firm has accumulated more complementary resources than a startup, or younger, firm. For example, a startup firm generally does not have a distribution network, whereas an established, or older, firm generally does. However, we acknowledge that a startup firm might have extensive industry contacts through its founders or advisors. The two proxies are also different: A startup firm can have a non-zero age at market entry, e.g., Amazon, whereas an established firm can still be young at market entry, e.g., Dell. Entry status is a coarse zero-one variable that can be determined rather objectively. Firm age at market entry is a finer-grained continuous variable, but more subject to debate. An older firm's complementary resources may be core rigidities (Leonard-arton, 1992). Additionally, marketing skills optimized for a long-existing customer base might be counterproductive when entering new markets (Christensen, 1997).

Nevertheless, following Lieberman and Montgomery (1998), it seems reasonable to assume generally that established or older firms have accumulated more complementary resources.

Fundamentally, our study involves evaluating whether current market leadership is a function of the amount of complementary resources that first movers and early followers possessed at market entry. For every product category in our sample, following the suggestion by Lieberman and Montgomery (1998), we attempted to determine market leadership, as of the end of our data collection in June 2006, on the basis of published *profits*. Such data is generally only available for publicly traded firms that publish results for the product categories in question. To ensure comparability across firms, published financial reports, including statements of profit and loss, are generally prepared according to Generally Accepted Accounting Principles (GAAP). When reports about GAAP profits were not published, e.g., for private firms, we tried to establish market leadership on the basis of *market share*. We note that first-mover advantages have been found more often in studies that only used market share as the metric for market leadership (VanderWerf and Mahon, 1997). For some I.T. product categories, market share data in terms of share of revenues was not available or not relevant. For example, web browsers have generally been available for free. Hence, the share of revenues of any firm would be zero percent. For such product categories, we determined market leadership on the basis of the level of *usage of the product*, e.g., the number of users or web site visits. We defined market leadership of firms that had exited the market as zero, regardless of which exact measure was relevant.

Because we used different measures for market leadership across different product categories, we analyzed market leadership *differences* within product categories. Consequently, we analyzed the *difference* in market leadership as a function of the *difference* in complementary resources.

Sample

Although we could not determine the first mover or the leader definitively for some I.T.-driven product categories, we found data for 72 firms across 25 product categories, yielding 45 pairs of first mover – current leader and first mover – non-leader, see Appendix A.

Statistical Tests

For proposition 1, we dropped one product category, namely Integrated Enterprise Resource Planning software, from the analysis, because the first mover and the current market leader were the same firm (SAP). Consequently, there was no *difference* to analyze. For entry status data, i.e., "established" versus "startup," we used the non-parametric sign test. For each product category, the difference at market entry was positive when the follower was an established firm and the first mover a startup. The difference was negative when the follower was a startup and the first mover an established firm. Finally, there was a tie when both follower and first mover were startup or both were established at market entry. If current leaders had more complementary resources at market entry than first movers did, we expected the number of positive differences to be higher than the number of negative differences. For the data about age at market entry, we used the z-test. For each product category, we calculated the age differential D_j, the age at market entry of the current leader minus the age at market entry of the first mover. If current leaders had more complementary resources at market entry than first movers did, we expected the average age differential to be positive.

For proposition 2, for the data on entry status, pair-wise comparison by product category resulted in a 3-by-3 contingency table: In terms of market leadership, the follower could be ahead of the first mover, behind the first mover or even with the first mover, e.g., when both had exited the market. In terms of complementary resources, the follower could have had more than

the first mover, or the first mover had more than the follower, or no difference. We used the chi-square test for independence, with 4 degrees of freedom. If current leaders had more complementary resources at market entry than first movers did, we expected the chi-square to be higher. A potential issue with interpreting the results of this test is that counts in many cells were less than five. Therefore, we also used discriminant analysis, with the dependent variable, difference in relative market leadership, a variable with three possible values: ahead, behind, or even. The independent variable, difference in complementary resources at market entry, was also a variable with three possible values: 1 when the follower was an established firm and the first mover was a startup, 0 when the follower and startup were both established or both a startup, or -1 when the follower was a startup and the first mover was an established firm. We also used discriminant analysis where the independent variable, difference in ages of the follower and first mover at market entry, was a ratio-scaled variable. The test statistic for discriminant analysis is Wilkes' lambda. If followers that lead over first movers had more complementary resources at market entry than first movers did, we expected Wilkes' lambda to be higher. Finally, for proposition 2, we also used a one-way analysis of variance with difference in age as the ratio-scaled dependent variable and difference in relative leadership as the ordinal independent variable. While this transposes the independent and dependent variables, it satisfies the assumptions of analysis of variance, which essentially determines correlation but not causation.

For proposition 3, we performed the same statistical analyses as for proposition 2. Additionally, we performed a multivariate regression of entry status and age at market entry, as independent variables, on overall market leadership and relative leadership as dependent variables. We performed all statistical tests with SPSS 14.0.

RESULTS

For two product categories, we could not conclusively determine who the first mover was: Personal computers and multi-protocol routers. We ran the analyses once with differences in these two product categories least favorable to the complementary hypothesis. We also ran the analyses again with differences most favorable to the complementary resources hypothesis, namely with Apple and Cisco, both younger firms, as first movers. The results below are for the latter analysis, and even then, they were still not statistically significant.

Proposition 1

Our data set contained 22 product categories, each with one pair, the first mover and a follower who is currently market leader, and their differences in entry status. Table 1 shows the cross tabulation.

	First Mover Entry Status		
	Startup	*Established*	*Total*
Established	4	12	16
Current Leader EntryStatus			
Startup	4	2	6
Total	8	14	22

Table 1: Entry status of leaders and first movers

The sign test indicates that the difference is not statistically significant ($p>0.25$). The average difference within pairs in age at market entry was 5.58 years with a standard deviation of 29.06 ($n=23$), a minimum of -56 and a maximum of +80. While the age difference is positive, as expected, it is not statistically different from zero ($p=0.18$). Hence, in I.T.-driven product categories, the difference in the amount of complementary resources at market entry between first movers and followers that are now market leaders was not statistically significant.

Proposition 2

Our data set contained 20 product categories, each with one pair consisting of the first mover and a follower who is currently not market leader. Table 2 shows the cross tabulation.

		Relative Market Leader			
		First Mover	*Neither*	*Follower*	*Total*
Entry status	*Follower startup; First mover established*	1	3	2	6
	Same	4	3	3	10
	Follower established; First mover startup	1	1	2	4
	Total	6	7	7	20

Table 2: Relative leadership versus entry status of non-leaders

The chi-square statistic of independence was 1.627 (p=0.804), hence insignificant, as was Wilk's Lambda in the discriminant analysis (p=0.72). The average age difference was 16.15 years with a standard deviation of 43.7 (n=20), a minimum of -49 and a maximum of +124. The relationship between the differences in age at market entry and differences in relative market leadership was statistically not significant (p=0.157) in both the one-way analysis of variance and discriminant analysis. Hence, in I.T.-driven product categories, the difference in the amount of complementary resources at market entry between first movers and followers who are currently not the market leaders was not statistically significant.

Proposition 3

Our data set contained 43 pairs, each containing the first mover and a follower, who may or may not be the overall market leader, as well as their differences in entry status and in *relative* market leadership. Table 3 shows the cross tabulation.

	(Relative) Market Leader			
	First Mover	*Neither*	*Follower*	*Total*
Follower startup; First mover established	1	3	4	8
Same	4		19	26

Entry status			3		
	Follower established; First mover startup	2	1	6	9
	Total	7	7	29	43

Table 3: Relative leadership versus entry status

The chi-square statistic of independence was 3.482 (p=0.481), hence insignificant, as was Wilk's Lambda in the discriminant analysis (p=0.367). The average age difference was 10.49 years with a standard deviation of 36.5 (n=43), a minimum of -56 and a maximum of +124. The relationship between the differences in age at market entry and relative market leadership was statistically not significant (p=0.607), in both the one-way analysis of variance and discriminant analysis.

Our data set contained 45 pairs, each containing the first mover and a follower, as well as their differences in entry status and in *overall* market leadership. Table 4 shows the cross tabulation.

		Follower is Overall Market Leader		
		No	*Yes*	*Total*
Entry status	*Follower startup; First mover established*	7	2	9
	Same	11	16	27
	Follower established; First mover startup	4	5	9
	Total	22	23	45

Table 4: Overall market leadership versus entry status

The chi-square statistic of independence was 3.794 (p=0.150), hence insignificant, as was Wilk's Lambda in the discriminant analysis (p=0.164). The average age difference was 7.32 years with a standard deviation of 39.4 (n=45), a minimum of -56 and a maximum of +124. The relationship between the differences in age and differences in overall market leadership was

statistically not significant (p=0.766), in both the one-way analysis of variance and discriminant analysis.

Discriminant analysis, analysis of variance, and multivariate linear regression all showed no statistically significant relationship between differences in market leadership (overall or relative) and differences in entry status and age at market entry (p>0.367). The interaction between independent variables was also statistically insignificant (p=0.325).

Hence, in I.T.-driven product categories, the difference in the amount of complementary resources at market entry between first movers and followers was not statistically significant.

SUMMARY OF RESULTS

Using various statistical tests on different subsets of our data about I.T.-driven product categories, we found no support for a relation between the amount of complementary resources and market leadership in I.T.-driven product categories. Thus, while complementary resources may well matter, we found that, at market entry, followers in I.T.-driven product categories, regardless whether they are market leaders or not, did not have significantly more complementary resources at market entry than first movers.

Implications for practice in I.T.-driven product categories

Our results suggest that in I.T.-driven product categories the amount of complementary resources a firm possesses at market entry does not predict whether that firm will take market leadership. In other words, market leadership does not appear to depend on a firm possessing a greater, or lesser, amount of complementary resources. In terms of organizational and competitive strategies, this means that established, or older, firms cannot count on their complementary resources to result in later market leadership. Conversely, startups' relative lack of complementary resources does not preclude later market leadership. Such insights are

relevant to executives in developing strategies and in investing in various resources, to investors, e.g., bankers, venture capitalists, or private equity funds, in deciding in which ventures to invest, and to potential competitors in deciding how to compete.

We found that strategic rivalry was often between early entrants who all had complementary resources. Most first movers and most current market leaders in our dataset were established firms at market entry. Among 22 product categories, 15 had first movers that were established firms at market entry, and 17 have current leaders that were established firms at market entry. In 4 out of 7 product categories in which the first mover was a startup, the current market leaders were also established firms. Thus, overall, current market leaders tend to have been established firms, and older than first movers, when they entered. And, most first movers were also established firms. Hence, if the first mover was an established firm, the eventual leader is very likely to be an established firm, albeit a different one from the first mover.

Implications for I.S. Research

Our results raise the possibility that market leadership is influenced importantly by factors other than complementary resources. For example, factors related to market dynamics may be important, such as the length of time customers need to develop brand loyalty or the length of time that the pioneer was in the market alone at first. Perhaps an important factor is the length of time between successive versions of the product, which is shorter in I.T.-driven product categories than in traditional product categories, e.g., consumer products. In order to bring I.T. products to market faster or to react faster to competitor actions, an important complementary

oligopolistic versus Schumpeterian competition, play a role in sustainability of entry order advantages (Williams, 1998). Another issue related to market dynamics is that market leadership changes over time, which raises the question of when market leadership should be measured.

It is also possible that complementary resources in I.T.-driven product categories play a role that our study did not detect. Two areas of limitations of our study readily present themselves: Our metrics/ proxies for complementary resources, and our sample. As mentioned earlier, because we could not find data on specific complementary resources, we constructed two general proxies, which may have dulled the significance of our results. Perhaps data can be found about other metrics of complementary resources, e.g., the members of the management team at market entry, their individual or collective skill levels, the level of initial working capital, number of patents or copyrights related to the innovation, geographical proximity of competing follower firms to the first mover or research universities, or revenues in the venture's early years. If reliable data for such particular metrics of complementary resources can still not be found, perhaps other proxies can be used, e.g., the number of employees as a proxy for company size. Obtaining fine-grained data of this kind would represent a considerable undertaking, but may be necessary to more fully understand the role of complementary resources.

Instead of other metrics for complementary resources, it is also possible that a *larger sample* would show the expected effects on market leadership. Or, perhaps a *different* sample should be studied, e.g., different product categories and/or firms. We note, for example, that prominent firms in several product categories in our sample have not earned any profits of significance, e.g., Amazon and Ariba. Perhaps one should mainly draw lessons from firms that have been consistently profitable. On the other hand, such a sample might be biased if profitable firms have more, or "better," complementary resources and/or make better use of them.

More generally, the research challenge may not be one of finding particular metrics for the overall amount of complementary resources. What if complementary resources cancel each other out, say, when large financial reserves are coupled with bad customer relationships, or good I.T. platforms coupled high rate of failures in application software projects? Perhaps only *particular* complementary resources play a role, e.g., inter-firm cooperation (Rothaermel, 2001), specialized complementary assets (Tripsas, 1997), or a customer base that is "co-specialized" with the innovation (Christensen, 1997). If particular metrics or particular complementary resources are important for market leadership, then longitudinal data can perhaps be gathered going forward and analyzed years hence.

Perhaps there are different categories of complementary resources and related strategies that are important for different organizations: For example, in the personal computer industry, Apple is well-known for its innovativeness and Dell is well known for its fast fulfillment of orders for customized equipment. If only particular complementary resources play an important role in particular industries, e.g., the number of retail outlets is relevant in some industries but not in others, then generalizability of results becomes a concern. Also, the theory of complementary resources may require development of dependency conditions among a large number of diverse assets; a task that would be challenging to the further advancement of the complementary resource hypothesis.

Given the importance of development of new markets in general and new I.T.-driven markets in particular, important questions remain that future research may help us understand.

REFERENCES

Bank Administration Institute "Relationship Management," *The Magazine of Bank Management*, December 1991.

Bryman, A. "Animating the Pioneer Versus Late Entrant Debate: An Historical Case Study," *Journal of Management Studies* (34), 1997, pp. 415-439.

Carroll, G. *Ecological Models of Organizations.*Ballinger, Cambridge, MA, 1988.

Christensen, C. , Harvard Business School Press, Boston, MA, 1997.

Crow, E., Davis, F., and Maxfield M. *Statistics Manual,* Dover Publications, New York, NY, 1960.

Dell'Oro "Dell'Oro Group Reports Optical Transport Market Grew 9 Percent in the First Quarter of 2006," , June 7, 2006.

Document Delivery World "The World's Largest Online Bookstore," *Document Delivery World*. February 1, 1993.

Gal-Or, E. "First Mover Disadvantage with Private Information," *Review of Economic Studies*, 1987, pp. 279-292.

Gans, J., Hsu, D., and Stern, S. "When does start-up innovation spur the gale of creative destruction?" *RAND Journal of Economics* (33:4), 2002, pp. 571-586.

Golder, P., and Tellis, G. "Pioneer Advantage: Marketing Logic or Marketing Legend," *Journal of Marketing Research* (XXX), 1993, pp. 158-170.

Goldman, A. "Top 22 U.S. ISPs by Subscriber Q1 2006," *ISP-Planet*, Jupiter Media, June 15, 2006.

Hidding, G., and Williams, J. "Historical Analysis of First-Mover Advantage in IT-driven Markets," *in Enabling Executive Information Technology Competencies,* A. Wenn and K. Dhanda (eds.), The Information Institute, Washington, DC, 2005.

Holland, P. "Statistics and Causal Inference," *Journal of the American Statistical Association* (81:396), 1986, pp. 945-960.

Kalyanaram, G., Robinson, W., and Urban, G. "Order of Market Entry: Established Empirical Generalizations, Emerging Empirical Generalizations, and Future Research," *Marketing Science* (14:3), 1995, pp: g212-g221.

Kort, T., Cozza, R., Maita, K., and Tay, L. "Dataquest Alert: Research In Motion Lifts PDA Market to 6.6 Percent Growth in 1Q06," *Gartner Research*, ID Number G00139918, May 5, 2006.

Kwak, M. "The Browser Wars," *Harvard Business School Case*, No. 9-798-094, 1998.

Leonard-Barton, D. "Core Capabilities and Core Rigidities: A Paradox in Product Development," *Strategic Management Journal* (13), 1992, pp. 111-125.

Lieberman, M. "Did First-Mover Advantage Survive the Dot-Com Crash?" Working paper, Anderson Graduate School of Management, UCLA, Los Angeles, October 17, 2002.

Lieberman, M., and Montgomery, D. "First-mover Advantages," *Strategic Management Journal* (9), 1988, pp. 41-58.

Lieberman, M., and Montgomery, D. "First-mover (Dis)advantage: Retrospective and Link with the Resource-Based View," *Strategic Management Journal* (19), 1998, pp. 1111-1125.

Lilien, G., and Yoon, E. "The Timing of Competitive Market Entry: An Exploratory Study of New Industrial Products," *Management Science* (36:5), 1990, pp. 568-585.

Mitchell, W. "Whether and When? Probability and Timing of Incumbents' Entry into Emerging Industrial Subfields," *Administrative Science Quarterly* (34), 1989, pp. 208-230.

Rothaermel, F. "Incumbent's Advantage through Exploiting Complementary Assets via Interfirm Cooperation," *Strategic Management Journal* (22), 2001, pp. 687-699.

Shapiro, C., and Varian, H. *Information Rules*, Harvard Business School Press, Boston, MA, 1999.

Schnaars, S. *Managing Imitation Strategies*, The Free Press, New York, NY, 1994.

Shankar, V., Carpenter, G., and Krishnamurthi, L. "Late Mover Advantage: How Innovative Late Entrants Outsell Pioneers," *Journal of Marketing Research* (XXXV), 1998, pp. 54-70.

Shankar, V., Carpenter, G., and Krishnamurthi L. "The Advantages of Entry in the Growth Stage of Product Life Cycle: An Empirical Analysis," *Journal of Marketing Research* (36), 1999, pp. 269-277.

Singleton, R., and Straits, B. *Approaches to Social Research*, Oxford University Press, New York, NY, 1999.

Stewart-Patterson, D. "Software House Is Key to Office System Design," *The Globe and Mail*, April 22, 1983, p. B13.

Stiller, R. with Marlow J. *Asunder: An Unauthoried History of the Origins of the JAVA Programming Language*, Briarwood Publications, Inc., Rocky Mount, VA, 1999.

Swisher, K. *AOL.com: How Steve Case Beat Bill Gates, Nailed the Netheads, and Made Millions in the War for the Web*, Times Books a division of Random House, Inc., New York, NY, 1999.

Teece, D.J. "Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy," *in The Competitive Challenge: Strategies for Industrial Innovation and Renewal,* D.J. Teece (ed), Ballinger Division of Harper & Row Publishers, New York, NY, 1987.

Tellis, G., and Golder P. "First to Market First to Fail? Real Causes of Enduring Market Leadership," *Sloan Management Review* (Winter), 1996, pp. 65-75.

Tripsas, M. "Unraveling the Process of Creative Destruction: Complementary Assets and Incumbent Survival in the Typesetter Industry," *Strategic Management Journal* (18: Summer Special Issue), 1997, pp. 119-142.

VanderWerf, P., and Mahon, J. "Meta-Analysis of the Impact of Research Methods on Findings of First-Mover Advantage," *Management Science* (43:11), November 1997, pp. 1510-1519.

Williams, J.R. *Renewable Advantage: Crafting Strategy Through Economic Time*, The Free Press, New York, NY, 1998.

APPENDIX A

This appendix presents the data by product category about who the first mover was along with its year of entry and similar data about the current market leader, based on data available as of June 2006, and about one follower, if any, that entered after the first mover and before the current leader entered. This appendix also presents, in the footnotes, a sample of the references we used to determine such data. To determine market leadership, we relied extensively on Factiva.

Product Category	First Mover (Entry year, Age, S/ E)	Current Leader (Entry year, Age, S/E)	Other Follower (Entry year, Age, S/E)
Online bookstores	BookStacks Unlimited (1992, 0, S)[2]	Amazon (1995, 1, S)	Barnes & Noble (1997, 124, E)
Web browsers	Spry Mosaic (1994, 5, E)[3]	Microsoft (1995, 20, E)	Netscape (1994, 0, S)
Online travel reservations	Travel Shopper (1985, 60, E)	Expedia (1996, 21, E)	American Airlines (1985, 55, E)
Integrated ERP	SAP (1979, 7, E)	SAP (1979, 7, E)	JDEdwards (1988, 11, E)
Client-side web applets	SUN (1994, 13, E)[4]	Microsoft (1996, 21, E)	-
Content management software	OfficeSmith (1983, 2, E)[5]	Vignette (1997, 2, E)	Interleaf (1984, 3, S)
Internet B2B market places	Trade'ex (1995, 10, E)	Ariba (1996, 0, S)	Vertical.net (1995, 0, S)
Integration brokers middleware	Neon (1996, 111, E)	IBM (1998, 84, E)	TIBCO (1998, 14, E)
CRM application suites	Florida Informanagement Services (1991, 10, E)[6]	SAP (1997, 25, E)	Siebel (1992, 2, S)
Online B2C auctions	OnSale (1995, 1, S)	eBay (1995, 0, S)	-
Online grocery delivery	PeaPod (1996, 7, E)	?	NetGrocer (1997, 2, S)
Online job boards	Online Career Center (1993, 1, S)	Monster (1994, 27, E)	-
Internet B2B market places software	Trade'ex (1996, 11, E)	Ariba (1996, 0, S)	Moai (1996, 0, S)
Internet service providers	The Source (1979, 1, S)[7]	AOL (1989, 7, E)[8]	Trintex (1984, 98, E)
Optical transmission equipment	GTE (1977, 21, E)	Nortel (1981, 100, E)[9]	AT&T (1977, 92, E)
Personal digital assistant (PDA)	Tandy (1989, 70, E)	Blackberry (1998, 14, E)[10]	US Robotics (1996, 21, E)
Personal computers	Apple (1977, 1, E) or Commodore (1977, 22, E)?	Dell (1984, 1, E)	-

[2] *See Document Delivery World, 1993*
[3] *See Kwak, 1998*
[4] *See Stiller, 1999*
[5] *See Stewart-Patterson, 1983*
[6] *Bank Administration Institute, 1991*
[7] *See Swisher, 1999.*
[8] *See Goldman, 2006*
[9] *See Dell'Oro, 2006*
[10] *See Kort et al., 2006*

Product Category	First Mover (Entry year, Age, S/ E)	Current Leader (Entry year, Age, S/E)	Other Follower (Entry year, Age, S/E)
Personal income tax software	Aardvark (1979, 0, S)	Intuit (1984, 11, E)	Howardsoft (1980, 0, S)
Price comparison websites	Pricewatch.com (1995, 0, S)	eBay Shopping.com (2005, 10, E)	DealTime (1999, 8, E)
Public key cryptography software	GTE (1984, 28, E)	Verisign (1995, 13, E)	RSA (1985, 3, S)
Multi-protocol routers	Proteon (?, 12?, E) or Cisco (1984, 0, S)?	Cisco (1984, 0, S)	3Com (1979, 8, S)
Search engine web sites	Webcrawler (1994, 133, E)	Google (1998, 107, E)	Lycos (1994, 94, E)
Short message service centers	Aldiscon (1991, 3, E)	Logica (1997, 28, E)	Vodafone (1992, 42, E)
Spreadsheet software B2C	Personal Software (1979, 3, E)	Microsoft (1985, 10, E)	Lotus (1983, 1, S)
Web advertising management software	IMGIS, Inc. (1994, 0, S)	Advertising.com (1998, 0, S)	DoubleClick (1996, 72, E)