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The Battle for Dominance: Innovating Firms' Strategic Market Success in the Context of a Standards War

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The Battle for Dominance: Innovating Firms' Strategic Market Signaling Behavior and Its Impacts on Market Success in the Context of a Standards War

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ABSTRACT

To increase the likelihood of success of their market-focused innovations, firms that develop innovations for targeted markets regularly communicate with market participants in order to reduce the uncertainties participants hold regarding the firms' innovations. Among other tactics, these firms employ strategic market signals. The paper develops three types of uncertainty (technical, market and standards) associated with the market-focused innovations as well as hypotheses related to the impacts of firms' signals, which are used to address the uncertainty issues, on firms' market success during the standards war. The research findings have implications for both theory and practice.

Keywords: signaling, standards war, business success

INTRODUCTION

Having a technological innovation prove itself successful within a product-market, even when it has obvious advantages, often proves difficult (Rogers, 1995) given the uncertainties surrounding its development and commercialization (Tushman & Rosenkopf, 1992; Utterback, 1994; Tegarden, Harfield, & Echols, 1999). In order to increase the likelihood that their innovations will achieve market success, innovating firms often seek to influence other market participants' views of their market-focused innovations. One of the more common influence tactics involves communicating information about the innovation via strategic signals (Utterback, 1994; Calantone & Schatzel, 2000; Prabhu & Stewart, 2001). A strategic signal involves "… any action by a competitor that provides a direct or indirect indication of its intentions, motives, goals, or internal situation" (Porter, 1980, p. 75).

The *dominant design*, an architecture that is widely accepted as the industry standard (Utterback, 1994; Anderson & Tushman, 1990), has been seen as a milestone that radically changes the nature of competition in an industry based on the innovation. The *standards war*, the period during which competing designs compete to be accepted as the dominant design, is the period when innovating firms' strategic actions have the strongest potential impacts on the firms' market success and the evolution of the innovation (Tushman & Rosenkopf, 1992).

During a standards war, technology leaders that develop competing designs and engage in the standards war to promote their technologies to be accepted as the dominant design face with different uncertainty issues - technical, market, and standards. Using strategic market signals to address these uncertainty issues, these leaders could influence the market success of their products and increase the likelihood that their products are accepted as the dominant design. In this research, we focus on addressing the research question: *How do technology leaders' innovation-related strategic market signaling behaviors influence their market success in the context of a standards war?*

THE DOMINANT DESIGN AND THE STANDARDS WAR

Over the last few decades, we have observed the occurrence of several "battles for dominance" between competing technologies to gain acceptance as "the standard" for an emerging technology. For example, such battles have been observed in the development of home video cassette system, internet browsers, and more recently, between HD-DVD and Blu-ray. The winning technologies of these battles are called *dominant designs* – that is, the designs to which most competitors, producers of complementary products and users adhere. Different theoretical perspectives on the evolution of innovation (e.g. Abernathy & Utterback, 1978; Tushman & Rosenkopf, 1992) converge at the conclusion that the emergence of the dominant design is an event that radically changes the competitive dynamics of products associated with the innovation along its life cycle (Suarez, 2004; Tergarden et al. 1995).

Different scenarios characterize the dynamics underlying a dominant design's emergence. A scenario that has drawn the attention of many researchers, and that is the focus of this study, is the *standards war* (Suarez, 2004). Here, competing designs are sponsored by one or more producers, each of whom hold a proprietary interest in a specific design and seek to persuade others to adopt this design as the dominant design (Suarez, 2004; Van de Ven, Polley, Garud, & Venkataraman, 1999). The design that wins over others becomes the *de facto* standard. A classic example of a standards war is the battle between Sony's Betamax and JVC's VHS for video cassette recorder standards, with VHS being adopted by the market as the dominant standard (Cusumano, Mylonadis, & Rosenbloom, 1992).

In the scenario of standards war, the emergence of a dominant design is driven by a negotiated logic that unfolds among market participants (producers, technology-users, manufacturers of complementary products, standards organizations etc.) interacting with one another (Tushman & Rosenkopf, 1992). Thus, innovating firms' technology and market strategies are likely to impact the dynamics and outcomes of the market-focused innovation evolution process and determine the firms' market success (Christensen, Suarez, & Utterback, 1998; Tushman & Rosenkopf, 1992).

During a standards war, a small numbers of *technology leaders* who sponsor competing designs and engage in the standards war to promote their designs to be accepted as the dominant design. Each technology leader's design is accepted by many followers (Link & Tassey, 1987). Therefore, for the technology leaders, their success, even survival, largely depends on the likelihood of their designs being accepted as the dominant design (Utterback, 1994; Das & Van de Ven, 2000). This study focuses on the technology leaders' strategic actions during the standards war, which are argued to have strongest impacts (Cusumano et al., 1992) on their market success and the evolution of their innovation.

NATURE OF THE UNCERTAINTIES ASSOCIATED WITH MARKET-FOCUSED INNOVATIONS

Prior research has identified three primary sources of an innovation's uncertainties (Suarez & Utterback, 1995; Tegarden et al., 1999; Das & Van de Ven, 2000; Sheremata, 2004): the innovation's *technical* features, the competitive *market* within which the innovation is applied, and the prevailing technical *standards* associated with the innovation's design. These uncertainty sources are briefly described in Table 1 and more fully described below.

Technical Uncertainty	- Relative advantage of technical characteristics
Market Uncertainty	- Fit with market demand - Actions of market rivals
Standards Uncertainty	- Existence of accepted standards / Compatibility with (widely) accepted standards/design - Actions promoting competing standards

Table 1. Uncertainty Types

Technical Uncertainty

Technology-centered approaches to innovation evolution (Christensen & Rosenbloom, 1995; Das & Van de Ven, 2000) explain innovation adoption largely based on an innovation's superiority, relative to competing innovations, regarding its technological capabilities. However, an innovation's technical advantage is fraught with uncertainty, especially early in the innovation life cycle (Utterback, 1994; Das & Van de Ven, 2000), since new technologies are anything but stable and ever-improved by their developers. A technical advantage today might be obsolete tomorrow given the innovative efforts of competitors.

Market Uncertainty

While technical inferiority may very well lead to an innovation's market failure, technical superiority does not guarantee acceptance of the innovation by the market (Das & Van de Ven, 2000). Research examining market uncertainty emphasizes two sources of uncertainty: demand uncertainty and competitive uncertainty (Beckman, Haunschild, & Phillips, 2004).

Demand uncertainty reflects the degree of fit between an innovation's functionality and that required by the market. While conceptually simple, this notion is pragmatically complex as the functionalities required by a market evolve (Utterback, 1994; Beckmamn et al. 2004) as the innovation, competing technologies and complementary technologies evolve. While firms can respond to demand uncertainty, its presence is never fully eliminated.

Competitive uncertainty is created through the actions of market rivals. In order to enter and build defensible positions in a market, firms engage in preemptive actions to manipulate the competitive environment, hoping to increase their success likelihood and, hence, market share and profits (Smith, Grimm, Gannon, & Chen, 1991; Teece, Pisano, & Shuen, 1991). Such

strategic moves typically involve actions associated with technical performance, market positioning, or both (e.g.Gilbert & Newberry, 1982; Schmalensee, 1983; Smith et al., 1991).

Standards Uncertainty

While the emergence of a dominant design essentially eliminates standards uncertainty exists with the existence of a dominant design (Tegarden et al., 1999), the lack of a dominant design dramatically heightens standards uncertainty. In the context of a standards war, two related issues in particular contribute to standards uncertainty (e.g. Link & Tassey, 1987; Tegarden et al., 1999; Tushman & Rosenkopf, 1992): the extent to which a focal innovation conforms to a competing design, and the likelihood that this competing design will win the standards war. Predicting which of a number of competing designs will eventually win a standards war is fraught with complexity as the likelihood that a given design will become the dominant design is influenced by the technical performance of competing designs and the market dynamics resulting from competitors' strategic moves, e.g., building an installed base, accumulating an array of complementary products, etc. (Katz & Shapiro, 1986; Wade, 1995), and the actions of other entities supporting the competing designs

STRATEGIC SIGNALING

Given these uncertainties, the commercial success of a market-focused innovation depends to a large extent on how well competing firms are able to influence market participants' views of their innovations. As a result, firms regularly make announcements or take actions that in turn are interpreted by market participants (Moore 1992; Calantone & Schatzel, 2000; Prabhu & Stewart 2001). Strategic signals take many forms but generally involve either messages (about intended and actual behaviors) to external constituencies or observable behaviors (i.e., strategic moves) (Heil & Robertson, 1991). Verbal statements in the form of announcements of intended actions are not expensive to deliver and have been found to have significant preemptive potential that influence other stakeholders' perception and behaviors (Heil & Robertson, 1991; Calanton & Schatzel, 2000). Thus, these announcements have potential to form relevant stakeholders' positive perception of the signaling firm's innovation and to pre-empt potential competitive actions by competitors, leading to positive impacts on the innovating firm's market success. Therefore, in this research, we focus on the technology leaders' verbal statements: communications regarding recent actions or anticipated strategic moves (Arndt & Bigelow, 2000; Calantone & Schatzel, 2000; Heil & Robertson, 1991).

STRATEGIC SIGNALING BEHAVIOR DURING THE STANDARDS WAR

The following sections discuss proposed hypotheses regarding the differential impacts of different types of strategic signals on technology leaders' market success during the standards war.

The Potential Impacts of Distinct Types of Signals on Technology Leaders' Market Success during the Standards War

The likelihood of individual innovating firms initiating signals and constituencies attending to signals is a function of the three uncertainty dimensions. Given their differing natures, these uncertainties will induce differential levels of attention by both innovating firms and attending constituencies, hence driving differential levels of signaling regarding the respective uncertainty dimensions.

The standards war period is characterized by continued technical progress as well as the emergence of both a viable market and a standards war, with firms vigorously seeking to build market presence and competing for their innovation to attain dominant design status (Utterback, 1994; Tushman & Rosenkopf, 1992). Technical, market, and standards uncertainties are each relatively high and moderately resolvable. Since the innovation's core functionalities have become codified across all stakeholder groups, technical improvements tend to be more regular and incremental. Therefore, it is necessary that the technology leaders focus on incremental innovations to gain or retain technical superiority of their products to meet the increasingly more varied and advanced requirements or to provide more advanced products at cheaper prices. Hence, technical signals are important to technology leaders in addressing these issues. The emerged market is comprised of customers holding increasingly varied requirements (Utterback, 1994). As a consequence, firms must demonstrate an ability to attract multiple customer segments by producing what each segment desires. Additionally, the increase in market entrants produces heightened competition for market presence. While market uncertainty remains high, the improved understanding of customer requirements results in a moderate level of market uncertainty resolvability. Thus, strategic market signals that attract customers, manage customer expectations and preempt competitive actions should enhance firms' competitive success (Suarez, 2004; Eliasberg & Robertson, 1988; Heil & Robertson, 1991). Finally, with the onslaught of the standards war, standards uncertainty is a critical issue. Strategic signaling that appropriately address standards issues would help technology leaders to manage the perceived likelihood of success of their product in the face of the standards war. These arguments lead to:

Hypothesis 1: *During the standards war, technical-, market-, and standards-oriented strategic signals will impact technology leaders' innovation market success.*

Given technology leaders' acknowledge technical prowess, the level of technical uncertainty is likely to be lower for technology leaders than are the levels of market uncertainty and standards uncertainty. The acknowledged technology prowess as well suggests a lesser need to signal strategically about technology gains relative to the need to signal about these firms' abilities to effectively respond to a variety of emerging market requirements (Utterback, 1994), to attract cohorts of adopters and complementary product producers (Katz & Shapiro, 1986; Schilling, 2002; Gallagher & Park, 2002), and to exhibit gained support for their innovation designs becoming the dominant design, i.e., addressing standards uncertainty. As a result, market information (about adoptions, about preemptive actions against competitors, etc.) and standards information (emergence of standards designs, support for standards designs, etc.) are more likely than is technical information to gain the attention of stakeholders. Hence:

Hypothesis 2: *During the standards war, for technology leaders, market-oriented and standards-oriented strategic signals will impact innovation market success to a greater extent than will technical-oriented strategic signals.*

RESEARCH METHODOLOGY

Event study methodology is used to assess the impact of the signals on technology leaders' market success, which was measured by abnormal returns in firms' stock price as the results of investors' reactions to delivered signals. Each signal is considered an unanticipated event that will potentially have significant impacts on the firms' abnormal stock price return. The following sections describe the data collection approach and analytic procedures.

Innovation Chosen for Study

Flash memory card technology was chosen for this study for several reasons. First, no flash memory card technology dominant design has yet emerged. The competition for dominant design status of flash memory card is left to the market where firms continue to engage in a *standards war* to drive their designs (e.g. CompactFlash, Memory Stick, etc.) to be accepted as the dominant design. Additionally, flash memory card technology is a recently introduced technology; thus, data on innovating firms' strategic signals and their stock prices are available. Table 2 lists the major competing flash card formats.

Format	Release Date	Producer	Notes
CompactFlash	Oct. 24, 1994	SanDisk	
SmartMedia/SSFDC	Nov. 13, 1995	Toshiba	40% of flash memory market by 2000, has since lost ground to Secure Digital format
Miniature Card	Jan. 24, 1996	Intel	Intel withdrew support in 1998
MultiMediaCard (MMC)	Nov. 5, 1997	Siemens and SanDisk	
Memory Stick	Oct. 7, 1998	Sony	
Secure Digital (SD)	Aug. 25, 1999	Matsushita, SanDisk and Toshiba	By 2005, the most popular format

Table 2. Major Flash memory card standards

The technology leader chosen for the study was Sandisk. Sandisk is a public company relying heavily on flash memory card sales for their revenues. Therefore the impacts of signals regarding flash memory products delivered by Sandisk on the firms' stock price are more likely to be observed.

Sampling Frame

Previous research has proposed several criteria for the identification of the start of the standards war, among them the abrupt increase of the number of firms in the industry and the introduction of competing formats (e.g. Utterback, 1994). Research was conducted on Computer and Telecommunications industries news releases and magazines (via Lexis/Nexis Academic Database) for materials about the flash memory industry to identify the number of flash memory card manufacturers over the years.

Figure 1 displays the variations of the number of firms in the industry from 1988 to 1998. Flash memory technology was first mentioned in industry magazines in 1988. From 1988 to 1993, the number of manufacturers was very small. In 1994, the number of firms increased dramatically from 6 in the previous year to 22. This was the year that CompactFlash was introduced, followed by the introduction of SmartMedia format in 1995. Therefore, the standards war is argued to start during the 1994-1995 period.

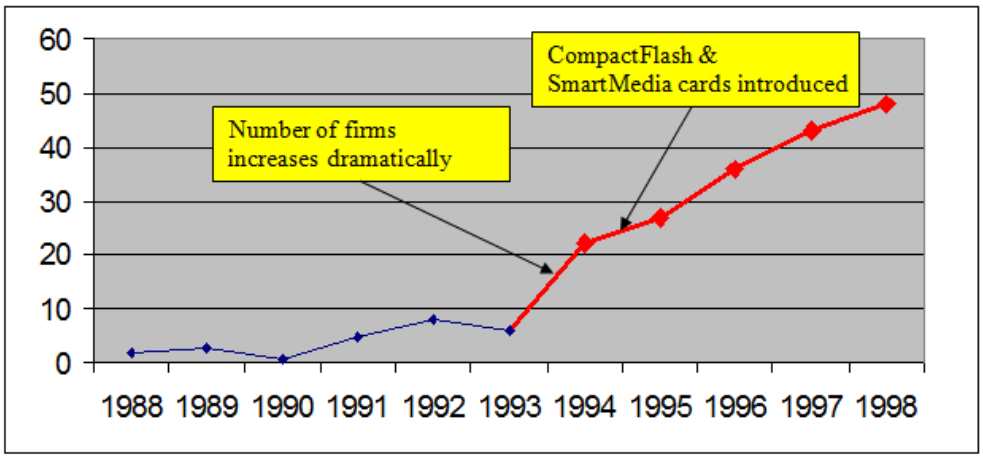

Figure 1. Number of firms in flash memory industry over the years
(Source: Industry news)

Signals Collection

The signals were collected from Business Wire and PR Newswire. The signals are Sandisk's messages, delivered in the form of press releases, addressing different aspects of their flash memory card products. In order to conduct event study analysis on a firm's stock price, it is necessary that the firm's stock price is available for a period of at least 250 days before the day of the signals for prediction of expected stock returns. SanDisk went public in October 1995. Therefore, signals were collected starting from 1997. This would leave a long enough time period for using prior market performance of Sandisk to estimate it's expected returns surrounding the days of the first collected signals. Signals data was collected from 1997 to end of 2005.

Data Coding

The identified press releases (announcements) were coded as carrying technology-oriented, market-oriented, and/or standards-oriented signals. The coding rules were developed based on the definitions of the uncertainty dimensions that the signals were used to address (See Appendix). Two people coded the signals independently. Afterwards, coding results of the two coders were compared, inter-rater reliability (Cohen's Kappa) ranges from 0.71 to 0.80, reflecting excellent inter-rater reliability.

Analysis and Results

Event study was used to analyze the impacts of different types of signal on Sandisk's stock price. A 3-day window was used to examine the impacts of the firms' abnormal stock return. While different studies have argued for different window lengths, 3-day window seems to be most appropriate for the type of event investigated, given the high frequency of them (e.g. (Dehning et al., 2004). The original dataset includes 227 announcements delivered by Sandisk. To retrieve a clean data set for event study analysis, confounding events need to be controlled for (McWilliams and Siegel, 1997). Signals that are delivered by Sandisk but are confounded by signals delivered by other competitors in a three-day window surrounding the delivery dates were removed from the data set. Additionally, confounding effects of other announcements delivered by Sandisk, such as quarterly financial reports, changes in management team, etc., are also controlled for. After controlling for all confounding events, the final dataset includes 84 press releases delivered by Sandisk.

An event study was run, using EVENTUS program, to investigate abnormal returns of SanDisk's stock price during a three-day window surrounding the delivery of the signals. Market-adjusted model was used to calculate abnormal returns during the three-day event windows. The use of market-adjusted model addresses two possible issues with the focal data set: 1) excludes Sandisk's prior sensitivity to market performance, since the period of analysis (1997-2005) included periods of

extreme market volatility caused by the internet bubble boom and bust; and 2) avoids the biased impacts on estimation of expected returns due to the existence of signals during estimation periods for other signals (Dehning et al., 2004).

Table 3 reports results of event study analysis with Sandisk's abnormal returns gained from the delivery of flash memory card-related announcements. Abnormal returns are reported for individual days from day -1 to day +1 surrounding the day of the announcements as well as the cumulative abnormal returns during the three-day period. Market-adjusted three-day CARs of Sandisk's stock price in response to Sandisk's flash memory card-related announcements are significant (CAR = 2.36%, p<0.01).

Market-adjusted cumulative abnormal returns (CARs) and z-statistics are shown for the day before (-1), the day of (0), and the day after (+1) the announcements, together with cumulate returns over the (-1, 0, +1) periods. Statistical tests are performed using standardized esiduals.

*p < .10; ** p < .05; *** p < .01

Window	Day -1	Day 0	Day +1	Days -1, 0, &+1
Market-adjusted returns				
Sample (N=84)				
Mean CARs	0.10%	1.53%	0.74%	2.36%
z-statistic	(0.019)	(2.34)***	(1.42)*	(2.18)***

Table 3. Cumulative Abnormal Returns (CAR) Around the Delivery of Flash Memory Card-Related Announcements

The next step is to match the coded announcements to the CARs to examine the impacts of different types of coded signals on Sandisk's CARs using multiple regression analysis. Each announcement was coded to carry technical-, market-, and/or standards-oriented signals. Each type of signal includes two sub-categories (see Appendix). Variables for the subcategories were used in the regression analysis. Table 4 represents the multiple regression analysis results. Three-day market-adjusted returns were used as the dependent variable. The dependent variable was not normally distributed. Therefore, a log transformation was applied, resulting in a normally distributed dependent variable.

Dependent Variable: Market-adjusted 3-day CARs (-1, 0, 1)

For each independent variable, value = 1 signifies a signal; 0 otherwise.

Unstandardized regression coefficients are shown with standard errors in parentheses

*p < .10; ** p < .05; *** p < .01

Independent Variables	**Model**
Intercept	-0.014
	(0.009)
T1: Statements of existing technical superiority	0.008
	(0.007)
T2: Projections of future technical superiority	-0.015
	(0.022)
M1: Statements reflecting that products meet market demands (customer-oriented perspective)	0.024***
	(0.008)
M2: Statements describing actions to increase sales and/or market share (competitor-oriented perspective)	0.009
	(0.008)
S1: Compatible with standards/widely accepted design	-0.010
	(0.007)
S2: Promoting a standards to become the dominant design	0.016**
	(0.007)
Adjusted R^2	11.8%
F Statistic	2.768
p-value	0.018

Table 4. Multiple Regression Analysis Results

Hypothesis 1, which argues that technical-, market- and standards-oriented signals have significant impacts on technology leaders' market success, is partially supported. While significant impacts of market- and standards- oriented signals on Sandisk's CARs were observed, technical-oriented signals were not found to have significant impacts on Sandisk's abnormal returns. The findings support hypothesis 2, which argues that market-and standards-oriented signals will have stronger impacts on technology leaders' market success than will technical oriented signals.

DISCUSSION

The following section will discuss the differences in the impacts of different subcategories of signals on innovating firms' market success and the study's implications for theory.

Technical-oriented signals were not found to have significant impacts on Sandisk's market success. Signaling about its technical superiority would help an innovating firm increase its market success when it competes on the market. However, doing it might not be critical to technology leaders. During the standards war, a technology leader's design's technical superiority over its competing designs might not be as important as the leader's strategic maneuvering capability to enlarge its installed base and complimentary products to guarantee likelihood of becoming the dominant design (e.g. Cusumano et al., 1992; Tushman & Rosenkopf, 1992). Additionally, technical superiority of a technology leader over a large number of technology followers is not unexpected news to the market. Therefore, it is reasonable that technical-oriented signals were not found to have significant impacts on Sandisk's market success.

With regards to market signals, it is interesting to note that market signals aimed at addressing the fit of the products with market demands (M1) receive positive significant reaction from the market. Meanwhile, signals directly aimed at communicating strategic actions in reaction to competitors' actions to gain market share (M2) are not significantly reacted to by the market. During the standards war, while a viable market for the new innovation has emerged, demands of the potential users of the technology are still not well defined. Additionally, this is also the period during which different variations of the new technology are promoted by producers to meet ever emerging demands and niches of potential users on the market, and the period during which the new technology competes with the old technology in meeting customer demands (Utterback, 1994). Therefore, market uncertainty would more likely come from meeting emerging demands than from specific strategic actions of competitors.

With regards to the two types of standards signals, it is interesting to note that standards signals aimed at indicting compatibility with already widely accepted formats (S1) are not significantly reacted to by the market. Meanwhile, standards signals aimed at promoting formats developed by Sandisk as the dominant design (S2) received positive significant market reaction. As a technology leader who develops and promotes its formats to be accepted as the dominant design, it is expected that Sandisk's products are compatible with its widely accepted design. Therefore, signals addressing the compatibility issue are not considered unexpected news to the market and thus did not receive significant market reaction. Meanwhile, during the standards war, Sandisk's designs' likelihood to become the dominant design would significantly influence market success, or even survival, of Sandisk's business. Therefore, the market would pay close attention to Sandisk's efforts in promoting its designs to become the dominant design. Hence signals addressing this issue were strongly reacted to by the market.

Implications for Theory

The paper's theoretical development and empirical findings have important implications for theory. By integrating insights from technology management, strategic signaling, and marketing literature, the study helps advance signaling theory by placing the theory in the context of standards development along the innovation life cycle. The study provides theoretical and empirical insights on the impacts of technology leaders' signaling strategy on their market success in the context of a standards war. The study suggests that signaling strategy that appropriately addresses the uncertainty issues faced by innovating firms would help increase the firms' market success, particularly in the standards war context.

The study has proposed different dimensions of uncertainty associated with the development and promotion of technological innovations in the context of standards war. Technical uncertainty is a relative concept, considered in the context of the evolution of the technological innovation along its life cycle. Market uncertainty, meanwhile, is a multi-faceted issue which involves both meeting flexible market demands and competing against competitors for market share. The study's results have shown that signals addressing the sub-categories of market uncertainty have different patterns of impacts on innovating firms' market success. Therefore, future studies should examine sub categories of market uncertainty separately.

Standards uncertainty is also a multi-faceted issue that requires separate investigation of the different sub-categorized standards uncertainty. The study's findings have shown that for a technology leader, efforts targeted at promoting its

technology as the future dominant design is more influential in increasing market success than addressing the compatibility of its products to different standards.

The study also lays the background for further research which aims at investigating innovating firms' signaling strategy in different contexts of standards development/evolution. Because of the complexity and multi-faceted nature of the standardization process, the study focuses on the development of *de facto* standards scenario only, the standards war. Strategic signaling behaviors in other contexts are also important (e.g. open standards, *de jure* standards) and need to be investigated in future research.

Implication for Practice

Finally, our research also has important implications for management practice. In developing and promoting new technologies during the standards war, managers of innovating firms need to be aware of the potential impacts of strategic signals as a tool to influence their firms' market success. During the standards war, managers need to focus on communicating to the market the different aspects of their innovations. In addition, from the adoption side, in making adoption decisions of emerging technologies, particularly ones with competing standards, managers faced with a broad range of options offered by the competing standards must also attend to factors other than the technologies' functional attributes in deciding which technologies to adopt, which standards to support, as well as when to adopt them. While the adoption of a successful new standard can help a firm gain significant competitive advantage, the late adoption of a promising emerging technology or the adoption of an old or losing standard would lead to a firm's loss of competitive advantage (Zhu, Kraemer, Gurbaxani, & Xu, 2006). Therefore, better understanding of the socio-political complexity surrounding technological standards and the standardization process and the potential impacts of different signaling tools on innovation evolution process would help managers of innovating firms and adopting firms with regards to a technological innovation develop better promotion and adoption strategies to increase market success likelihood of their companies' technologies and avoid being "trapped" in losing or abandoned standards, respectively.

CONCLUSION

The development and commercialization of a technological innovation, particularly in the scenario of the standards war among competing designs, entails tremendous uncertainties. Uncertainties arise not only from the internal technological development activities of the producers but also from the strategic actions of all market participants. In order to survive and prosper in this highly dynamic environment, innovating firms actively strive to influence the perceptions of market participants.

Strategic signaling has been seen as an effective means with which to influence market participants. However, little is known about innovating firms' strategic signaling behaviors and how these signaling behaviors can influence firms' market success. Drawing from literature in strategic management of technology, marketing, and economics, the ideas developed herein and the empirical findings shed new light on how strategic signals, which are used to address uncertainty issues, will influence the firms' market success. It is hoped that the research will lead others to direct their attention, both theoretical and empirical, to this important phenomenon.

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APPENDIX: CODING SCHEME AND CODING SAMPLE

Uncertainty Dimension	Sub-dimension coding
Technology	***T1***: Statements of existing technical superiority (Relative advantage of technical characteristics versus competing technologies)
	T2: Projections of future technical superiority (e.g. new patent, collaboration to develop new technology
Market	***M1***: Statements reflecting that products meet market demands (Products that meet existing/potential market needs)
	M2: Statements describing actions to increase sales and/or market share (Competitive strategy to increase sales and market share of existing products)
Standard	***S1***: Compatible with standards/widely accepted design
	S2: Promoting a standards to become the dominant design (Strategy to increase installed base & complementary products/technologies)

Table 1. Coding Scheme

Announcements	Coded signal
Business Wire February 12, 1998, Thursday **HEADLINE:** SanDisk CompactFlash Memory Cards to be Included in New HP PhotoSmart C20 Digital Camera; One SanDisk 4MB CompactFlash Card Will be Included With Every HP PhotoSmart C20 Digital Camera Sold **BODY:** Feb. 12, 1998--SanDisk Corp. (NASDAQ:SNDK) today announced that Hewlett-Packard Company will use rugged, reliable and economical CompactFlash(TM) memory cards provided by SanDisk as the removable digital film in the new HP PhotoSmart C20 digital camera,…. …. HP's decision to employ small-size CompactFlash cards in the new PhotoSmart C20 digital camera continues a strong industry trend by camera and computer manufacturers to design digital cameras using CompactFlash as the digital-film. CompactFlash has set an industry standard for small removable data, image and audio storage….	Coded as a market-oriented signal, sub category M2 Coded as a standards-oriented signal, sub category S2

Table 2. Coding Sample