THE INTERFACE OF STRATEGY AND DIFFUSION THEORY

by

S. KUESTER*
H. GATIGNON**

and
T. S. ROBERTSON †

98/87/MKT

* Assistant Professor of Marketing at ESSEC, France and Visiting Assistant Professor of Marketing at New York University, USA.

** Professor of Marketing at INSEAD and The Claude Janssen Chaired Professor of Business Admnistration, Boulevard de Constance, 77305 Fontainebleau Cedex, France.

† Candler Chair and Dean of the Goizueta Business School, Emory University.

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Sabine Kuester

Hubert Gatignon

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Thomas S. Robertson

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Sabine Kuester is Assistant Professor of Marketing at ESSEC, France and Visiting Assistant Professor of Marketing at New York University, Hubert Gatignon is the Claude Janssen Chaired Professor of Business Administration and Professor of Marketing at INSEAD, France and Thomas S. Robertson holds the Candler Chair and is Dean of the Goizueta Business School, Emory University.

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Abstract

Consumer and organizational behavior perspectives have dominated research on the diffusion of innovations in marketing, until recently. New research now focuses on the strategic issues of the diffusion process and on their implications for innovation management. In this paper, our basic tenet is that strategy affects adoption behavior and, therefore, the diffusion of innovations. Therefore, we investigate the key strategic issues, which should be considered in the study of the diffusion of innovations and the implications for the marketing of the innovations.

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INTRODUCTION

Diffusion theory, regardless of the domain of inquiry (agriculture, medicine, education or industry), has focused on the forces which determine the adoption and diffusion of innovations. Although individual and organizational attributes within the social system have dominated research until now, a recent emphasis of diffusion research and modeling has been placed on the interface of strategy and the diffusion process. Our basic tenet is that strategic decisions of the firm affect the behavior of consumers and, in particular, the diffusion of new product innovations.

This view is particularly relevant for marketing because it espouses the principle that the speed, with which a population within a social system adopts an innovation can be significantly influenced by the management of that innovation. Especially crucial are the strategic marketing decisions which may accelerate or retard the adoption of the innovation. In most situations, management is interested in increasing the speed of diffusion, although it may be more profitable in some cases to accept a slower acceleration. These cases would include: 1) to optimize of profits until competitors enter the market, especially if the innovation cannibalizes the firm's existing products, 2) to send signals to possible entrants that the market is small, or 3) to maintain a quality image (as opposed to mass market).

In this paper we focus on the strategic factors which affect the speed with which an innovation may diffuse. Our approach can be contrasted with most of the prior literature which has focused on explaining the adoption process from the point of view of the consumer who is faced with a new product alternative. That literature and models of the diffusion of innovation have especially analyzed the interpersonal communication process, as opposed to factors controlled by the firm marketing the innovation.

According to diffusion theory, those who innovate communicate the product's benefits to others through interpersonal communication, which can be verbal, such as word-of-mouth, or visual (Rogers 1995). This behavioral explanation of diffusion has been validated in the context of the commercialization of innovations where interpersonal communication plays a major role in consumer decision making. Interpersonal influence reflects the influence of early adopters

who relay information that can change attribute beliefs and reduce the perceived risk for other consumers. Consistent with the literature viewing the adoption process in a decision theoretic framework (Jensen 1982; Chatterjee and Eliashberg 1990), adoption takes place when the perceived relative advantage of an innovation is greater than the hurdle of adoption, represented by price and/or cognitive hurdle (Sinha and Chandrashekaran 1992). The customer's expected value of benefits from a new product potentially increases as more information becomes available and uncertainty is resolved (Jensen 1982; Kalish 1988).

Therefore, diffusion is generally characterized by a slow start, and then a subsequent rapid increase in sales as the innovation is accepted by the majority of the market. If the market has a finite limit, there comes a point when most of those inclined to buy the product have already adopted. Thereafter, we observe a decline in sales as saturation occurs. The sales history of a product encompassing these different stages defines the life cycle of an innovation. It is evident that some of the determinants of the life cycle display some inertia, which makes them nearly impervious to managerial action. Most of the components of the adoption decision process mentioned above, however, can be controlled managerially. For example, the perceived uncertainty associated with adoption can be influenced by the strategic decisions of the firm marketing the innovation. Thus, diffusion should not be viewed as an "inevitable" process, but instead the players in the market can affect the level and timing of the life cycle stages. Understanding why certain dynamic sales patterns occur and which roles marketing strategy plays in the diffusion process is of significant managerial relevance, especially for market development. We try to explain diffusion as a decentralized process – at the firm level for newly introduced products – as opposed to a process where it is assumed that innovations come from a centralized source and diffuse from there. Schoen (1967) criticizes this "center-periphery model" and describes the diffusion process as one triggered by multiple sources from which innovations evolve (Rogers 1995).

In line with previous research (e.g., Robertson and Gatignon 1986; Gatignon and Robertson 1989) we posit that strategic choices have an impact on the diffusion process. Diffusion modeling approaches, for example, have taken into account marketing mix variables to demonstrate their effect on the process of adoption (e.g., Lilien, Rao and Kalish 1981; Horsky and Simon 1983; Horsky 1990; Jain and Rao 1990) suggesting that different marketing strategies

may generate different diffusion patterns. However, this stream of research has remained limited, especially to the role of marketing mix variables, in spite of the recognition that the life cycle of an innovation is in part a strategic choice (for example, when a manufacturer decides not to introduce an innovation in order to prevent cannibalization with an existing product). Therefore, we are especially interested in the impact of key strategic choices, particularly when innovations are characterized by a technological dimension.

These key strategic decisions which we propose are: i) the technological choices made by the supplier(s) of the innovation and ii) the firm's entry strategy in the market place. In studying the technological choices of the firms, we are mainly concerned with the issues of: a) core capabilities, b) whether the new technology is competence destroying or competence enhancing, c) the compatibility of the technology with other products, and d) the extent to which the technology is appropriable by other firms. The major questions regarding the entry strategy concern: a) the decision to be the first in the market (i.e., the order of entry issue), b) the commitment level made by the firm and the signal it gives to the market, c) the marketing mix decisions to be taken, especially the role of distribution, which has received less attention in the literature despite its importance on the diffusion of an innovation, d) the pre-announcement strategy, and e) the strategy of acquisition of capabilities or know-how. The effects of a firm's strategy on the diffusion of an innovation are summarized in Figure 1, where the dependent variable of interest is the speed of diffusion. Our objective is to review the literature concerned with these issues in the hope of encouraging future research in these directions which should have a significant impact not only on our understanding of the diffusion of innovations but also on the marketing management of new products.

– insert Figure 1 about here –

Although strategic choices are not independent of the environment characterizing the firm introducing the innovation (Gatignon, Weitz and Bansal 1990), as shown in Figure 1, we do not intend to review this large literature base whichis mainly rooted in the field of strategy. Instead, we focus on the link between strategy and diffusion. However, to the extent that this link may be moderated by the environment and/or that some environmental characteristics have a direct

impact on the diffusion of an innovation, these characteristics should not be totally excluded from this review. For example, our premise of a decentralized diffusion process implies the existence of multiple change agents. For this reason, it is critical to consider the moderating effects of competitive variables. Similarly, we will also discuss the impact of changes in the technological environment and the increasing role of network externalities. Figure 1 shows these three moderating variables: i) competitive environment, ii) technological change and iii) network externalities. We first discuss the impact of strategic choices on the diffusion of innovations and in the second section, we attempt to understand how environmental factors affect diffusion and moderate the influence of strategic choices on the diffusion of an innovation.

IMPACT OF STRATEGY ON DIFFUSION

The early diffusion modeling tradition, similar to the strategic literature on the product life cycle, was mainly concerned with the description of time-evolutionary adoption behavior. In order to enhance the relevance of this research domain for descriptive but also prescriptive use, efforts have been made to understand the influence of marketing decision variables on adoption behavior and diffusion. The Bass model has been extended to study variables such as price (Robinson and Lakhani 1975; Kalish 1983, 1985; Kamakura and Balasubramanian 1988; Jain and Rao 1990), advertising (Horsky and Simon 1983; Simon and Sebastian 1987) and distribution (Jones and Ritz 1991).

We intend to build on this stream of research in order to provide further insight into diffusion-inducing strategy options that are relevant in complex market environments, such as technology-based industries in competitive oligopolistic settings. The role of technological choices appears particularly critical in today's markets, especially for durable goods (both consumer and industrial) which are the focus of diffusion research. These issues of technological choices are first discussed and then the entry strategy options and their impact on diffusion are presented.

Technological Choices

As mentioned above, we will discuss four key strategic options: core capabilities, and whether the innovation is competence enhancing or competence destroying, product compatibility, and technology appropriability.

Core Capabilities. The management literature has repeatedly amplified the notion of core competencies or capabilities (e.g., Teece 1986; Prahalad and Hamel 1990). Core capabilities refer to the knowledge a firm has built over time (Leonard-Barton 1992) and which constitute a unique set of resources in that they are difficult to duplicate by other competitors (Prahalad and Hamel 1990). These distinctive competencies can be deployed systematically in order to carve out a sustainable competitive advantage.

The notion of core capabilities is not new and is the essence of the resource based view of strategy (Rumelt 1974; Hayes 1985; Hitt and Ireland 1985), which dominates current research in strategy. For example, Prahalad and Hamel (1990) discuss capabilities that are institutionalized within the firm and which give it an opportunity for strategic differentiation. Such a capability can be the ability to coordinate diverse production skills and to integrate multiple streams of technologies. According to Prahalad and Hamel, a core competence should provide potential access to a wide variety of markets and, therefore, constitutes an experience factor that potentially facilitates the commercialization of new products. Ansoff (1965) already emphasized the impact of experience in technology and marketing on market success. Maidique and Zirger (1985) also pointed-out that successful new products are often a result of those competencies. The same core competencies, however, can also constitute core rigidities that hinder successful commercialization of innovations, since institutionalized capabilities may render a firm inflexible when environmental conditions change – a phenomenon which is referred to as "incumbent inertia" (Lieberman and Montgomery 1988). This may especially be the case when a change in the technological paradigm occurs, for example, when: i) technological discontinuities arise (Tushman and Anderson 1986), or ii) when architectural innovations emerge (Henderson and Clark 1990). We discuss this issue below and also as a moderating factor later in the section on technological change.

This discussion can lead to two opposite streams of research. The first one concerns the positive effect of core capabilities for the firm. Especially, the ability to coordinate across functions and markets may be a condition for the development of innovations which will be accepted by consumers and which will enable the firm to achieve a fast diffusion across markets or countries.

The second research stream may emphasize the problems associated with strong core capabilities. These problems, however, can be of two different natures. In one case, strong core capabilities may limit the strategic vision or scope of the firm, which may then lead it to not take advantage of other options. The other type of problem is due to changes in the technological competitive environment which renders particular core capabilities obsolete. This last case is an example of the idea that a strategic choice (a core capability) has a varying effect depending on the competitive environmental conditions. As a superior technology becomes available in the market, the core capability advantage may become a handicap. This issue is discussed further in the section about the moderating role of the environment.

Competence enhancing vs. competence destroying. A number of dimensions have been proposed to characterize innovations. Although Gatignon and Robertson (1991) reviewed characteristics of an innovation mainly from a behavioral viewpoint, the technology management, strategy and organizational behavior literatures have recently developed new concepts which, given the importance of the interface between these functions of the organization, may have a significant impact on the innovations which are being brought to market and, consequently which may affect the adoption and diffusion of these innovations.

One important dimension is expressed in the concept of the radicalness of an innovation. This issue has previously been discussed in marketing from a behavioral point of view (e.g., Robertson 1971). The technological viewpoint (Dewar and Dutton 1986) has recently been at the forefront of innovation research. "...discontinuities are breakthrough innovations that advance by an order of magnitude the technological state-of-the-art which characterizes an industry" (Anderson and Tushman 1991, pp.26-27). The radicalness of an innovation can be viewed as the expression of the firm's strategy. Indeed, Gatignon and Xuereb (1997) show that the ability to develop a radical innovation follows from the strategic orientation of the firm. While these radical innovations may be slower to penetrate the market, the potential market may be greater than the potential of continuous innovations.

A related concept is the one of competence destroying versus competence enhancing innovations (Tushman and Anderson 1986). Similarly, it offers a significant potential for better understanding differences in diffusion rates and shapes across innovations. "A competence

enhancing discontinuity builds on know-how embodied in the technology that it replaces," whereas "a competence destroying discontinuity renders obsolete the expertise required to master the technology that it replaces" (Anderson and Tushman 1990, p.609). The strategic issue concerning which types of firms tend to develop competence enhancing innovations versus competence destroying innovations is important in order to understand competitive strategies. A proposition that should be verified is whether firms which develop competence enhancing innovations obtain faster diffusion than those which develop competence-destroying innovations. This is, in fact, a critical characteristic because the same innovation can be competence enhancing for a particular firm and competence destroying for another firm. Consequently, this can offer a sustainable competitive advantage in that the competitor for whom it is a competence destroying innovation is likely to delay adoption.

Product Compatibility. As pointed out by Katz and Shapiro (1985), the network externalities which affect the diffusion of innovation are not simply generated by direct effects due to the number of consumers who have adopted the innovation, but they are also generated by the indirect effects due to the penetration of compatible products. This issue of compatibility is especially relevant for technological innovations where standardization enables: 1) uses of products together, 2) minimization of learning requirements, and 3) decreased uncertainty about the future of the technology. For example, the ability to combine camcorders with televisions using the same standard, such as NTSC or PAL increases the utility of camcorders. More recently introduced digital systems may be able to achieve an even greater level of compatibility with audio, video and computer technologies, which facilitates and improves home video editing. This constitutes a real benefit to consumers who may, therefore, be more likely to adopt digital camcorder technology rather quickly.

Products using non-complementary technologies often present different interfaces for using these products resulting in significant learning requirements for consumers. When products are compatible, consumers achieve economies of scope for learning how to use these compatible products. Consequently, some of the barriers to adoption due to these learning requirements are removed or significantly reduced (Gatignon and Robertson 1985). The decreased uncertainty about the future of the technology can be illustrated with the Mini Disk technology. While

available first in the format of portable players, the fact that the technology exists also in car audio systems, for example, signals to the consumers that it is becoming a standard. This can be contrasted with Digital Audio Tape recorders, which are basically only available as part of a component stereo system.

The economics' literature has focused on the motivation for firms to choose compatible technologies especially in markets where network externalities exist (Farrell and Saloner 1985; Katz and Shapiro 1985, 1986; Gilbert 1992). The role of private versus social incentives has been assessed especially in the equilibrium strategies of firms. The firm's incentives to achieve compatibility revolve around the opportunity to eliminate inter-technology competition and, consequently, the uncertainty surrounding the network, which will dominate. The pursuit of compatibility may allow the firm to charge higher prices, since consumers are willing to pay a premium for compatibility. This is due to the fact that compatibility allows them to access a larger network, or to assemble a product system that is closer to their ideal configuration (Matutes and Regibau 1988; Economidies 1989; Economides and White 1994). It may also be that achievement of compatibility is costly (Katz and Shapiro 1986). Costs to achieve compatibility include the incremental expense of design and development and the expense of negotiating to reach a standard (Besen and Farrell 1994).

By contrast, the choice of launching a product with a technology which is incompatible with an existing installed base, or with emerging rival technologies, may retard market acceptance and alter the competitive dynamics. The market potential may remain smaller with less than complete compatibility than under industry-wide compatibility (Katz and Shapiro 1985). Also, consumers may postpone their purchases when they have uncertain expectations about the network. This will reduce the speed of diffusion. On the other hand, deliberate incompatibility protects returns from R&D and conveys a credible signal of the firm's ability to control the market in the future (Padmanabhan, Surendra and Srinivasan 1996).

Technology Appropriability. A technology, which is controlled by a firm, may lead this firm to invest more in market development, especially through lower prices. This assumes the existence of network externalities (Katz and Shapiro 1986). When the technology can be appropriated, the benefits of compatibility through greater network externalities may be compensated by the

industry being locked-in to a dominant technology standard. Therefore, on the one hand, an imitator may benefit from a first mover advantage when developing a technology, for which it does not control the property rights. On the other hand, control of the property rights can lead to greater long term profits, once the market has been developed. Consequently, the strategic choice of a firm regarding whether to use a proprietary technology or one which can be appropriated, is not always clear, in the absence of information about the likelihood and characteristics of future alternative technologies.

Entry Strategy

Pioneering or Late-Entry Strategies. The issue of entry timing has received considerable attention in theoretical and empirical research. Mostly, the focal question is whether pioneers enjoy a distinct competitive advantage over later entrants. The marketing literature has focused on the empirical evidence for a first-mover or market pioneer advantages with many consistent positive results (Abell and Hammond 1979; Biggadike 1979; Whitten 1979; Robinson and Fornell 1985; Urban *et al.* 1986; Lambkin 1988; Robinson 1988; Miller *et al.* 1989; Moore, Boulding and Goodstein 1991; Kalyanaram and Urban 1992; Bowman and Gatignon 1996) although with some recent controversy (Kerin, Varadarajan and Peterson 1992; Golder and Tellis 1993).

Research has focused mainly on the impact of pioneering strategies on business performance and advantages may stem from the ability to shape consumer preferences early on in the diffusion process, technological leadership, establishing switching costs, specifying distribution channels, lower costs through economies of scale, learning curve effects, and generating reputations as market leaders. Three types of effects have been demonstrated: i) a main effect for order of entry (Urban *et al.* 1986), ii) a recursive effect whereby pioneering leads to, for example, better products, and, consequently, to faster adoption (Robinson and Fornell 1985, Robinson 1988), and iii) asymmetric marketing mix effectiveness (Bowman and Gatignon 1996, Parker and Gatignon 1996). These effects have led to the conclusion that pioneering results in higher long-run market shares for pioneers compared to later entrants in an industry. Pioneers, however, are also exposed to a higher risk of failure (Kalyanaram and Urban 1992) and are vulnerable to later entrants that free-ride on technological breakthroughs or that take advantage

of changes in consumer preferences (see Szymanski, Troy and Bharadwaj 1995, for a recent critical assessment of the literature).

Kerin, Varadarajan and Peterson (1992) make the important suggestion that pioneer advantages are moderated by product and market characteristics and they conclude that they are most pronounced in markets which remain stable for an extended period of time. Consequently, emerging industries and industries that go through technological change will exhibit different pioneering or order of entry effects than in less turbulent market environments. Anderson and Tushman (1990), for example, found that in emerging technology markets, the pioneering technology was never dominant suggesting a high risk of failure for first or early movers.

Despite the rich theoretical and empirical base of order-of-entry impact on long-run market share, little is known with regard to the effect of a particular entry strategy on the diffusion process. Sujan (1985) found that products of late entrants diffuse faster compared to pioneering products. This is due to the fact that customers have insufficient initial product knowledge that slows adoption. Later entrants then benefit from subsequent consumer learning. This finding is supported by Kalyanaram and Urban (1992): in their cross-sectional sample, in which they control for differences in marketing expenditures, they found that later entrants suffer a long-run market share disadvantage. The order of entry penalty are evident both in trial and repeat purchase behavior. Their results on the dynamics of order of entry effects suggest, however, that later entrants approach their lower levels of share at a higher speed. This result is intuitively appealing as the customer's expected value of benefits from a new product potentially increases as more information becomes available and uncertainty is resolved (Jensen 1982; Kalish 1988). In a similar vein, Parker and Gatignon (1996) study order-of-entry effects on trial diffusion and conclude that me-too products face less initial trial resistance than the pioneering brand. They also observe faster take-off, although this effect is mitigated by the diffusion of competitive brands, i.e., the later the entry, the stronger the negative competitive influence.

Therefore, the strategic decision to enter the market first and, more generally the order of entry strategy, has a significant impact on the diffusion of an innovation in terms of speed and long term penetration. This impact is due to several sources of competitive advantages which appear to be sustainable in the long term.

Market Entry Commitment. A firm's resource commitment plays an important role in determining the speed of technology diffusion (Robertson and Gatignon 1986). In the preparatory and actual phase of the launch, we often observe that firms adopt penetration strategies which entail aggressive pricing and high resource commitments to advertising, sales force and promotional activities. The selection of such penetration strategies is driven by the objective to gain rapid market acceptance and, thus, to stimulate demand through a diffusion effect (Kalish 1988) but also to benefit from cost reductions through learning effects (Dean 1969; Robinson and Lakhani 1975) and to discourage competitors from taking an equally strong stance in the market.

Pricing plays an important role in this strategy, as a lower price will reduce the adoption hurdle for the potential adopter and, therefore, stimulate demand. In some cases firms will then try to recuperate the margin loss incurred by offering low prices to first adopters by increasing the price successively for customers adopting later in the cycle due to the social imitation process. Penetration pricing seems to be most suitable when a strong social contagion effect can be assumed (Van den Bulte and Lilien 1997). Penetration pricing was a key strategic issue in the 1970s (Abell and Hammond 1979) as the concept of experience curve effects was promulgated. It regained importance (especially in technology markets) when the existence of network externalities tends to discourage customers from early adoption until the uncertainty concerning the future network is resolved (Farrell and Saloner 1985). Penetration pricing is often coupled with high initial levels of spending on advertising. Although advertising plays an important demand inducing role, firms generally decrease their advertising effort gradually over the life cycle (Horsky and Simon 1983) as advertising elasticities decline over time (Parsons 1975; Arora 1979). The optimization of advertising spending over the life cycle may depend on the strength of the imitation effect that is assumed to occur.

In summary, marketing mix decisions, especially pricing and advertising, are important indicators, although not exclusively, of the commitment made by the firm to the market. Other indicators may be plant size and production capacity or other investments in non-reversible assets. In general, we can expect that the stronger the commitment to entry, the faster the speed of diffusion of the innovation.

Marketing Mix: Distribution. The role of marketing mix variables has been reviewed by Gatignon and Robertson (1991). They propose to analyze the role of the marketing mix variables along three constructs of the adoption process: i) innovation awareness, ii) willingness to pay the market price, and iii) availability of the innovation. Price and communication activities influence mainly the first two components of this adoption process. These factors have received a significant amount of attention in the diffusion modeling literature in the past. Recent contributions have been to assess empirically the changes in the importance of price and advertising as the innovation diffuses and achieves high levels of penetration in the population (Parsons 1975; Parker 1992; Parker and Gatignon 1996; Parker and Neelamegham 1997). However, availability appears increasingly to be a significant strategic factor, either because of restricted production levels (technologically imposed or self imposed, for example as a way to avoid risks due to uncertain demand conditions), or because of limitations in distribution channels. The assumption in most of the diffusion literature (possibly due to the epidemiological analogy where a virus is ready to infect new bodies) is that the innovation is available if the consumer is ready to buy. The channel literature demonstrates the strategic role of distribution.

The role of distribution on diffusion has received some attention, but to a much lesser extent than the other marketing mix instruments. Indeed, Jones and Ritz (1991) have recognized that the adoption of an innovation by consumers is conditional on the innovation being distributed by the channels of distribution. The study of the penetration of the innovation in the channel of distribution is therefore critical to understand the patterns and rates of diffusion in the population of users. Although distribution may be instantaneous in some cases, this cannot be assumed to be generally true. Little empirical evidence can be found to understand the evolution of the number and type of stores carrying an innovation.

This diffusion among distributors follows a process, which has been described conceptually. Distributors carry the innovation if there is indication of potential (Farley and Leavitt 1968; Jones and Mason 1990). This depends on the marketing activities promised by the manufacturer of the innovation, but also on the consumer response as can be observed from early distribution. Diffusion also depends on inter-channel dynamics among channels, which may be either competing or complementary (for example, specialized vs. mass market channels).

Therefore, two issues need to be investigated: (1) the simultaneity of adoption between the distribution system and consumers, i.e., consumers can only adopt if the innovation is carried by the distributors, but the distributors will only carry the innovation if the consumer response is sufficient and (2) the diffusion pattern of the distribution, and especially the inter-channel dynamics, as these impact the diffusion of the product among consumers.

The first issue is particularly important as the power of the channels of distribution may be increasing throughout the world as retail concentration becomes more prevalent. This increasing power may continue with multinational mail order channels and the recent enthusiasm for marketing on the world wide web. The adoption of a new product by a large distributor being complex (Montgomery 1975), it is critical to understand the diffusion of innovations by those who make it available to consumers. Yet, there is little empirical data on how distribution spreads within and across chains. It is likely that diffusion is different for the various potential channels for an innovation.

The role of each channel is different in that it may reach different segments of consumers which exhibit different patterns of adoption. For example, innovators may be more likely to purchase in specialist channels. If this is the case, some channels may bring better information than others regarding the success of the innovation in terms of responses from consumers. On the other hand, because of the mass market targeting of some channels, diffusion may reach its maximum if such mass channels adopt. However, these patterns of diffusion in the various channels may lead to strong competitive effects. For example, when the mass merchandisers cut the prices in order to generate growth for the product category, it may spoil the market for the other channels who may even stop carrying the product.

Pre-announcing. Eliashberg and Robertson (1988) have found that the vast majority of external pre-announcements are to customers, although they can be directly to competitors as well. Pre-announcing conveys information about a forthcoming product to consumers and other audiences. In doing so, it can facilitate the creation of an installed base by potentially reducing customers' costs of changing from an existing product or technology to an emerging one and by ameliorating information asymmetries between the firm and its customers. The reduction in

switching costs is due to the consumer's ability to plan the migration to the new technology over a more extended time parameter.

Capability Acquisition via Alliances. The strategy to enter a market may depends on the skills available within and outside the organization. The literature on mode of entry into foreign markets is probably the richest in terms of the examination of factors affecting the decision to enter alone or using a partner and whether with equity or not (Anderson and Gatignon 1986, Gatignon and Anderson 1989). However, this is not simply an issue for international marketing, but also for the development and marketing of many innovations.

Robertson and Gatignon (1998) examine the decision to develop a new product internally or in partnership with another firm. A transaction cost framework is used to derive and test what drives this decision. However, the impact on the speed of the diffusion of the resulting innovation is not the object of their study. Similarly, partnerships in the distribution channel, which adopt a similar transaction cost approach, have not examined diffusion effects. However, a transaction cost explanation, which concerns the efficiency of the strategy used, means that the cost dimension plays an important role, which may affect the demand side. Consequently, it appears that new perspectives are needed to assess the impact of these decisions on the speed of diffusion of innovations. The premise would be that the manner in which capabilities are acquired within or outside the organization affects not only the innovation capabilities of the firm but also the speed with which innovations produced by the firm diffuse.

We have developed a number of issues which have been discussed to different degrees in the literature. In general, there has been little empirical validation of these explanations and a number of important questions need to be addressed to provide generalizable conclusions. This could be useful for explaining the diffusion of innovations and could potentially have a significant influence on the behavior of manufacturers and distributors.

THE MODERATING ROLE OF ENVIRONMENTAL FACTORS

Competitive Environment

New technology/innovation competition is either inter-firm specific (e.g., different standards and/or brands are competing) or intra-firm specific (different technology generations compete with each other within a firm). The latter case (Norton and Bass 1987) calls for a reflection on how marketing strategy can influence adoption behavior in order to avoid unwanted adoption resulting in cannibalization.

Inter-firm competitive effects on the diffusion process have been demonstrated in terms of the propensity to being negatively influenced typically by the penetration of competing brands (Parker and Gatignon 1994). It appears to be the case also that competitive marketing mix actions negatively affect the diffusion rate of a new brand.

Industry concentration. The industrial organization paradigm deals with how market structure determines the conduct and performance of firms. Scherer (1980) identifies various features of market structure – specifically, the number and size of firms, homogeneity of the market, cost structure, barriers to entry, and vertical integration. Market structure affects the manner in which firms choose to compete in the industry which, in turn, influences the diffusion process (Robertson and Gatignon 1986).

The number of competitors affects the level of expected cooperation and, hence, the level of competitive rivalry (Scherer and Ross 1990). Research in industrial organization, for example, suggests that rivalry tends to intensify as the number of competitors increases and as they become more equal in size and capability. Similarly, Moore and Moore (1990) show that rates of cooperation are lower as the number of subjects that participate in an interaction increase. From these arguments we can infer that the lower the level of industry concentration, the higher the level of competitive intensity.

Our interest is in examining the effect of competitive intensity on the diffusion process and how the strategic choices of firms in an industry foster diffusion. It seems intuitively appealing that under conditions of high competitive intensity, greater resources are allocated to the market and more competitive price decisions are likely to occur, thus encouraging rapid

market acceptance and, therefore, a faster diffusion of new products (Brown 1981; Robertson and Gatignon 1986). The diffusion modeling literature has paid particular attention to the pricing of innovations. Eliashberg and Jeuland (1986) show, for example, that prices tend to decrease when a competitive new entry occurs and, consequently, demand increases.

The diffusion modeling literature, in a desire to make managerial recommendations concerning optimal pricing strategies under different levels of industry concentration and competitive intensities, has made assumptions concerning how prices affect the diffusion of innovation. For instance, in their pioneering work of optimal pricing dynamics in a monopoly, Robinson and Lakhani (1975) posit that price affects the remaining market potential and conclude that, when word-of-mouth effects are assumed to be a strong driver for new product diffusion, a penetration pricing strategy is optimal. Eliashberg and Jeuland (1986) find that if an incumbent expects the entry of a rival, penetration strategies become even more aggressive. However, the role of competitive marketing mix variables on the diffusion process is not always clear. Jain and Rao (1990) suggest that price affects the rate of diffusion by influencing the coefficients of external and internal influence of the Bass diffusion model. More recently, the interest has focused on the impact of competitive effects in oligopolistic settings on the diffusion process. Parker and Gatignon (1994), for example, modeled competitive effects in brand-level diffusion models and found that competitive marketing mix variables were critical in explaining the diffusion of brands. However, these effects were not identical across brands and were not symmetric. Further research focusing on the explanation of these asymmetries would be appreciated.

However, concerning the role of entry strategies, highly competitive markets should exhibit a smaller pioneering advantage and the commitment of the firm to entry may not be as critical as when markets are less competitive.

Competitive Resource Commitment. It is also reasonable to assume a relationship between the level of competitive resource commitment and the diffusion process. In order to stay competitive in an emerging market, firms have to play the game according to certain rules and competitive norms of conduct, often reinforced by benchmarking. If, for example, a large industry player enters the market with a low price strategy, rivals have to do likewise in order to stay

competitive. A high resource commitment in an industry is also an indicator of competitive intensity. In such environments we can expect that the diffusion process is positively influenced. In addition, we would expect an interaction with the firm's strategic choices; collaboration and compatibility may be more effective in markets with high levels of competitive resource commitment.

Technological Change

Technological evolution and change are consequential for the process of diffusion. There is a substantial literature on technological evolution which tries to explain how a new technology or new technological capabilities evolve (Sahal 1981; Dutton and Thomas 1985). Day and Kimberly (1992) point out that, in addition to the development of a technology, the emergence of supportive and institutional innovations (e.g., infrastructure development, market channel development, dissemination of information), and market response (from other competitors and from the customer base) have to be considered. Only with such an integrative approach will researchers be able to explain why certain diffusion patterns prevail.

Theories of technological evolution have generally been classified into two broad categories, namely "technology push" and "demand-pull" theories. The first theory (Phillips 1966) places a major emphasis on the role of innovation in scientific knowledge, i.e., it views technology as the "prime mover". "Demand pull" theories point to market forces as the main determinants of technical change. Tushman and Anderson (1986) conclude, however, from an analysis of many different technologies over years of evolution, that neither of these theories alone seems to be adequate to explain the emergence of new technological markets. Rather, technology seems to evolve in response to the interplay of history, individuals and market demand (Sahal 1981).

A central concept in the literature on technological innovation is the distinction between refining and improving existing products, processes or systems versus the introduction of a new paradigm that departs in a significant way from past practice (Dosi 1982). Incremental innovation refines and extends an established design. Improvement occurs in individual components, but the underlying core design concept, i.e., the technological paradigm, remains the same. A radical innovation establishes a new technology paradigm and hence, a new set of

core design concepts. It is assumed that a major determinant of adoption behavior is the degree to which the consumer perceives the latest technology as superior to the existing technology (Rogers and Shoemaker 1971). An innovation that departs radically from existing products is surrounded with more uncertainty and, therefore, adoption behavior will exhibit different patterns than incremental innovations. This discontinuity dimension has been proposed earlier (Robertson 1967) but there is a relative paucity of research that examines the effects on established consumption patterns.

The distinction between "radical" and "incremental" change is based on a common punctuated equilibrium model of how industries and technology-based organizations evolve. This model describes how industries remain relatively stable until the *status quo* is interrupted by specific events, such as radically innovative technologies. These events then trigger chaotic periods characterized by rapid changes (Page, Wiersena and Perry 1990).

There is increasing recognition, however, that this punctuated equilibrium model does not apply to a variety of today's industrial settings, in particular to those that have been characterized as uncertain and rapidly changing (Bahrami and Evans 1989; Covin and Slevin 1989; Eisenhardt and Bourgeois 1989). In such environments – such as, for example, in high-technology settings – a punctuated disequilibrium model may be more appropriate. This model assumes that there are no long periods of stable design convergence. Instead, discontinuity and change are the norm and innovation is technologically driven. Under such conditions, new firms seeking a technological gateway to an industry will be more likely to pursue "architectural innovations" rather than radical or revolutionary change (Henderson and Clark 1990). An architectural innovation is the reconfiguration of an established system to link together existing components in a new way. According to Henderson and Clark (1990), this form of innovation is often triggered by a change in a component. An architectural innovation can be very consequential for industry players. Consumers, however, will be more familiar with products where an architectural innovation is embodied and, therefore, less uncertainty will be perceived with an architectural innovation than with a radical one. Compatibility with exisiting technologies, learning requirements and switching costs would also typically be lower. Consequently, diffusion will be faster than for innovations that radically depart from previous technology.

Evolutionary theories attempt to explain why industries are forced into new technological domains but they fail to portray why some industries evolve rapidly, quickly building a substantial customer base, while other industries show only slow growth. From a managerial point of view, it is important to understand that, depending on the innovativeness of a new product, risk perceptions on the part of the consumer differ.

There are also a number of studies that suggest that incumbents often fail to pioneer new developments and that, in fact, *new* competition will be able to overcome existing entry barriers through innovation to create gateways of entry into an industry (Yip 1982). This is especially the case when technological paradigms change. The industrial organization and management literature has been successful in identifying the reasons why incumbents often fail to be early entrants into new technical fields and markets (Arrow 1962; Reinganum 1983; Hannan and Freeman 1984; Tushman and Anderson 1986; Ghemawat 1991). The dominant reasons for this failure are fear of self-cannibalization and "incumbent inertia". Reinganum (1983) provides the theoretical support for this phenomenon by showing that an established competitor invests less than a new entrant, if the entrant develops a sufficiently revolutionary innovation. Her result can be explained by the potential cost of cannibalization of the revenues from the incumbent's existing products.

Cases where established competition is out-flanked by new competition are by no means isolated. In fact, a common empirical finding is that the first companies to introduce major innovations frequently are newcomers to an industry. Indeed, new competition has an important impact on technology development , as has been suggested by a number of studies in economics. According to Scherer and Ross (1990), new entrants stimulate the diffusion of new products and technologies directly through their own development of innovations and indirectly as "spurs" to established competition. Consequently, the order of entry benefit discussed in the prior section should be moderated by the rate of technological change to the point that the pioneering advantage may disappear when the rate of technological change reaches a threshold.

Network Externalities

Some industries are characterized by complementarity in consumption of their product with other products. In such cases, the utility attached by consumers to the industry's product depends on the penetration of these other products as well. Therefore, the existence of network

externalities can have an influence on the diffusion path of an innovation (Katz and Shapiro 1986; Tirole1988). We refer to these *positive* network externalities when a product is *more* valuable to a user when more users adopt the same product or compatible ones. Although many examples are in electronics, standards do not apply only to high-technology and affect more mundane articles such as lamp batteries, typewriter keyboards or ski-bindings (see David 1985, for an account of the adoption of the QWERTY keyboard). Externalities can either be direct or indirect (Tirole 1995). The former arises from the benefits of an increasingly large number of users in the same network (i.e., telephone users connecting to the same network). Indirect externalities accrue from the benefits of a growing network in the form of increased availability of compatible products.

The presence of network externalities has important consequences for the demand and supply side. On the demand side network externalities lead to a coordination problem. Due to the interdependency of their utility functions, consumers have to anticipate which technology will emerge as dominant. The problem of conflicting preferences regarding the choice of a particular technology can lead to two potential inefficiencies: 1) the consumer postpones adoption (excess inertia), or 2) quickly adopts a technology for fear of getting stranded (Katz and Shapiro 1986). Farrell and Saloner (1985) find that when network externalities are present, customers tend to be discouraged from early adoption until the uncertainty concerning the network is resolved (Farrell and Saloner 1985). Consequently strategies which reduce uncertainty, such as compatibility of products and standardization of technologies, will be more effective in these environments.

On the supply side the existence of network externalities influences the way that technologies are chosen, i.e., it leads to the choice of a particular technology to be adopted by most industry players (Matutes and Regibeau 1988). These standards are often mandated by government or industry committees, but a large amount of standardization is actually left to the marketplace and is mostly supported by dominant firms (Tirole 1995). When technology choices have to be coordinated by market forces, incumbent firms can achieve compatibility either individually (through the choice of a particular technology) or by encouraging other industry players to adopt the same technology (Farrell and Saloner 1985). They may also choose to keep their products incompatible. In these early phases of market development, consumers will be uncertain about the technology that will prevail and this will have a negative impact on diffusion.

CONCLUSION AND MANAGERIAL IMPLICATIONS

Our intent in this analysis of the interface between strategy and innovation diffusion has not been to be exhaustive, but rather to suggest some promising areas of research which we consider to be important for gaining understanding of the diffusion of new commercialized products. Such understanding will also help marketers to develop their new product introduction strategies. While significant progress has been made over the last decade in studying the impact of managerial actions on the diffusion process, this review and the questions we raise should encourage marketing scientists to develop new streams of research in order to expand the extant theories concerning the role of firms as change agents in the dissemination of new products, ideas, practices or services.

Our overall conclusion is that the actions of business firms have a major effect on diffusion processes. Unlike classical diffusion theory (Rogers 1995), an innovation does not emanate from a single centralized source and maximum diffusion acceleration is not always the dominant objective. Instead, individual firms may market multiple versions of an innovation and may have different diffusion objectives depending on their resources and the potential for cannabilization of their existing technologies. What we propose is a refined theoretical perspective combining classical diffusion theory with extant strategy theory. The end result should be a theory of greater realism and applied value to business enterprises.

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Figure 1: Conceptual Model