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The interaction between product concept and institutional inducement: a new driver of product innovation

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Abstract

The findings of our study clearly suggest that "product concept" drives product innovation. The very term "product concept" itself is often used in a vague, almost philosophical way: though it appears frequently in economic literature, the authors of this report feel that its true significance is not widely recognized. However, based on the enterprises we examined in the course of this study, not only is the notion of "product concept" frequently invoked by managers as an operational objective, but it does actually play an important role in product development. Technological innovation can take place at various stages of the process of product innovation, but this does not mean that it is absolutely the "driving" force behind product innovation. Rather, our study found that technological innovation occurred in order to give a product concept actual "material substance". Moreover, we observed that technological innovation plays a vital role as a strategy in creating competitive barriers between companies and their competitors. But following Kuhn, who first demonstrated that innovation is the creation of new paradigms, we found that product innovation occurred in the wake of new concepts. In other words, technological innovation is pulled along by the advance of product concepts.

Keywords: Product concept; Concept-driven product innovation; Institutional inducement; Learning-curve effect; Field management

1. Introduction

The term product innovation is often confused with technological innovation. A commonly heard refrain in the business community is, "We will grow our business through revolutionary technological innovation". But except when applied to either parts manufacturers, small or medium sized enterprises with a limited amount of essential technology, or venture businesses, this expression is imprecise. Rather, what one ought to say is, "We will grow our business through revolutionary product development".

The findings of our case studies suggest that there is a very important distinction to be made between these two words, especially from the point of view of corporate strategy. We have reached this conclusion based upon the following two observations: (1) in order to bring about product innovation, technological innovation must be preceded by concept innovation, and (2) concept innovation triggers technological innovation and marketing innovation.

However, we can make no claim that our findings have universal significance. Rather, they are only the result of a very limited number of case studies and, moreover, consist only of inferences drawn based on large, successful Japanese companies. Yet we believe, as others before us have demonstrated (Hanson, 1958; Sebeok and Umiker-Sebeok, 1980; Eisenhardt, 1989) that our methodology is one eminently suited to the investigation of new phenomena and innovations for which there is not copious amounts of data available.

Our findings are the result of four years of research conducted on 13 different Japanese enterprises which, despite being in the midst of the long recession caused by the end of Japan's bubble economy, continued to record strong profits. For instance, Fig. 1 indicates how the Canon's printer business has strategically been contribu-

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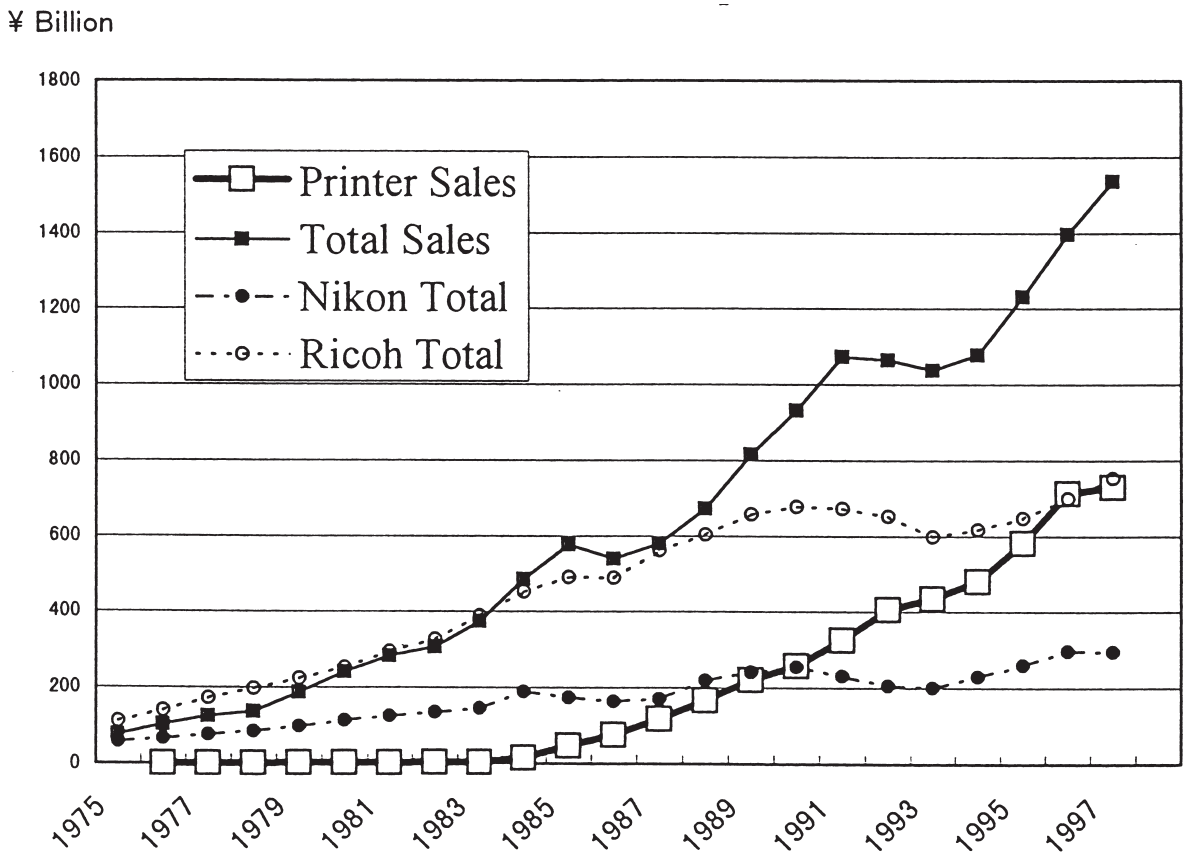

Fig. 1. Canon's and its competitors' sales.

ting to its total sales growth, in comparison with its major competitors, Nikon in camera and Ricoh in office equipment businesses, despite the stagnant period after 1990 in Japan.

These enterprises represent a diverse range of industries. That is to say, our sampling is made up not only of technology-based firms but includes companies from both the service and manufacturing sectors, such as makers of consumer-products and industrial materials. Because some of our research data could only be obtained on the condition of strict confidentiality, we are not able to reveal the names of any of the firms, but Table 1 gives a breakdown of the firms according to industry. The 13 firms were chosen from a pool of 40–50 companies based on a study of available literature. We eliminated from our research companies who posted profitable earnings due to special conditions such as the sale of assets, as it was deemed that these would not make reliable case studies. One surprise of our findings was that, regardless of industry, these successful enterprises had all chosen to adopt product-concept-led product-innovation strategies.

Table 1
Breakdown of the firms intensively studied

Types	Industries (number of firms)
Technology-based	Pharmaceutical (1) Electronics (1)
Materials/industrial products	Chemicals (2) Industrial products (2)
Consumer products	Food and beverages (2) Electronics (2) Households goods (1)
Service	Service (1) Financial (1)
Total	13 firms

Furthermore, we also examined prior research on product innovation to determine how its role has been assessed up until now. From that research we were able to create a classification of product innovation. This classification can be divided into 3 main categories: (1) first-mover versus late-mover, (2) incremental versus radical, and (3) technology-driven versus market-driven.

To begin with, if we understand the first category to include the notion of entrepreneurship in the broader sense of classical economics, we can trace its origins back to 1755 when Cantillon first proposed it.

What Cantillon (1755), and other economists who came after him have argued—in particular Say (1833), who showed great interest in this idea—was that it is the entrepreneur who assumes the burden or risk and therefore reaps the most profit (first-mover profit and first-mover opportunities). Of course, Schumpeter (1912) also made a similar argument. More recent scholars who

have studied innovation have also pointed out the potential for modern entrepreneurs to enjoy first-mover profits (Lieberman and Montgomery, 1988; Kerin et al., 1992). For a more detailed discussion of first-mover advantage one should refer to other literature, such as that by Kerin et al. (1992) which is based on in-depth analysis. After Schumpeter, the main characteristic of theories on this subject is a distinction between entrepreneurs and capitalists and a recognition that it is the capitalist who enjoys first-mover profits. One must keep in mind the context of the division between management and ownership which took place in the early 1900s, producing the first modern industrial corporations (Chandler, 1990). Incidentally, Chandler is also the only person to have stressed the advantages of first-time enterprises.

What has become clear from our empirical study is that thanks to the dissemination of the JIT system among American and European enterprises from the late 1980s to 1990s, the advantageous position of assembly-production-centered Japanese industries has diminished and the focal point for structural advantage is shifting away from process innovation toward product innovation. This in turn suggests that first-mover advantage is even greater than before, while the profitability of adopting a follower, or "me-too" strategy has diminished. This would account for the fact that all of the successful enterprises in our study have adopted a first-mover strategy.

The first-mover advantage through product innovation which we observed is primarily due to innovation in technological development. Therefore, in that the realization of product concepts depends in part upon the development of new essential technologies and core components, the major problem that innovative companies face is protecting the patents on that new technology from me-too companies who seek to imitate it. On this subject, the Executive vice-president of Sharp Corporation states, "At our company, product development is driven by concept innovation, but in order to realize such concepts there's always got to be a technological breakthrough. Technology has become so complex recently that even if you wanted to copy it, you couldn't get the necessary parts, or even figure out how it worked for that matter".

In this case, what becomes a barrier against competition from me-too companies is not merely the level of innovation, but also the speed at which it can be realized in new products, and the degree (time-frame) to which one is ahead of one's competitors. A Managing Director at Canon stated that what enabled his company to enjoy a first-mover advantage with its LBP (Laser Beam Printer)—which has an 80% global market share, accounting for 1/3 of Canon's total sales—was a 3-year technological head-start over their competition. A product developer at Sony Corporation even conceded that Canon had had at least a two-year advantage.

Marketing and distribution can also help create barriers to entry against competitors, and serves to magnify the advantage of technological leadership. With concept-led product innovation, by definition the concept is very clearly defined from the start. Therefore: its selling-points vis-à-vis consumers is readily apparent. Furthermore, as we shall see later, these selling-points can be strengthened during the product development phase, and more still through an effective marketing strategy. For example, Fuji Photo Film, having received comments from consumers that they hadn't been able to take pictures somewhere because they had forgotten to take their camera, decided to greatly increase the distribution of its Quick Snap disposable camera. They added souvenir shops and restaurants in tourist spots to the list of sales outlets, which already included camera and photo developing stores, where it could be purchased.

Of course, this was before Fuji's competitors had begun imitating the Quick Snap. In general, such distribution strategies are proving less and less effective, especially as a measure against first-mover advantage gained through product innovation. Japan's leading beer producer, Kirio Breweries, in order to stop its slide in market share against competitor Asahi Breweries' Super Dry brand, undertook a major restructuring of its distribution network, abandoning a policy of distributing only to liquor stores (as opposed to supermarkets and convenience stores). Nevertheless, Kirin continued to lose ground to Asahi. While Kirin's No. 1 position was originally gained by virtue of its distribution system, such a strategy is crumbling in the face of Asahi's product innovation-driven strategy.

As for the second category in our framework, the main proponents of radical versus incremental innovation were Schumpeter (1912) and Kuhn (1962). Schumpeter used the following analogy in asserting that innovation could only be brought about by non-sequential changes: "No matter how many horses you hitch up to a mail wagon, it still won't stand a chance against a steam locomotive". Kuhn, on the other hand, defined innovation as a paradigm shift in the way people think, i.e. something that changes the way people look at the world. In other words, both of them stipulated that only radical change could constitute innovation.

Moreover, in recent years, studies of this problem have pointed out that when the competitive environment of the market place undergoes a significant change, companies that had enjoyed a competitive advantage in a former situation need to produce a radical innovation in order to extend that advantage under a new set of circumstances (Dosi, 1988; Pavitt, 1990).

On the other hand, certain studies do recognize the importance of incremental product improvements, especially given a stable market situation (Banbury and Mitchell, 1995).

Yet even if one has a conceptual grasp of the difference between radical and incremental innovation, in

practice it can be difficult to distinguish between the two except in extreme cases. One study that managed to shed some light on this matter was by Henderson and Clark (1990). The introduction to this report states: "The traditional categorization of innovation as either incremental or radical is incomplete and potentially misleading". It goes on to propose instead the concept of "architectural innovation". Henderson and Clark's model of innovation is divided into four separate categories consisting of two dimensions. One dimension contains the "components" which make up a product; this is divided between two concepts of "reinforced" or "overturned". The other dimension consists of "linkages between components", which can be either "changed" or "unchanged". By combining different pairs from each dimension, one finds that there are four different "innovation types" which can be identified. On one extreme is "incremental innovation" which is defined as the combination of "reinforced" and "unchanged", while at the other extreme is "radical innovation", consisting of both an "overturn" in component concept as well as a "change" in linkage.

When the subjects of this study are compared with the Henderson and Clark model, one sees the following phenomena:

- new product concept development
- consequential partial overturn in components
- change in component linkage.

From this, we can say that the companies in the study exhibit something close to radical innovation.

The third category in our study, technology-driven versus market-driven, is a distinction made by many other researchers. Such an argument leads logically to the importance of technology–market linkage. Our findings also show evidence of development toward such a model. The companies in our study made the following assumptions when undertaking product development:

- The product is one that its competitors are not making, perhaps even the first of its kind in the world.
- It is perceived by consumers as being lifestyle-enhancing or value-added.

In other words, based on the companies in our study, the determinative dimension of product innovation is the conjunction between a product's ability to create a gap, or barrier, between oneself and one's competitors, and to appeal to the values or lifestyles of consumers.

While technology bears most of the burden of creating competitive advantage, it is the product's ability to reflect market needs that is responsible for meeting the expectations of consumers. In other words, business strategy must be premised on an awareness of the importance of technology–market linkage.

It is our belief that such a thought process lies at the root of product innovation, and therefore we will treat category (3) in greater detail in the next section of this report.

What follows is a brief outline of this paper:

In the next section, Section 2, we will thoroughly examine the process of product development for the companies in our study, referring to the views both of advocates of technology-driven and market-driven approaches.

Section 3 encompasses three distinct conceptual frameworks. The first is premised on squaring our findings with those put forward by earlier research. In this regard, we will advocate our view of "Concept-Driven" Product Innovation. The second framework will lay out the functions of "product concept" which constitute the basis for our findings. Finally, the third framework will demonstrate the concepts governing the process and management of Concept-Driven Product Innovation.

The final Section 4 has been reserved for a discussion of future research.

2. Understanding the technology-driven/market-driven dichotomy

2.1. Technology-driven versus market-driven

This classification has been expressed in various ways including "technology-push versus market-pull", "technology-led versus market-led," and "product-push versus demand-pull". As Dosi states in his literature-based study of this problem, an argument for such a dichotomy was made as far back as 1957 in the work of Johnson and Jones (1957).

The main focus for this debate has been placed on the relative effectiveness of technology-driven and market-driven approaches in bringing about product innovation.

First of all, several studies have reported findings suggesting that innovation is the result of a deep understanding of the market and user needs (Rowthwell et al., 1974; Conway and McGuinness, 1986; von Hippel, 1988; Ottum and Moore, 1997) Conway and McGuiness studied 35 search processes and reported that roughly 75% of search processes have an early stage of idea detection that take into account market needs, while 6 out of 9 companies in their study had adopted a market-driven management strategy. Therefore, they concluded that there is no support for the assertion that pure technological ideas and innovations are the prime initiating force behind product development.

On the other hand, some researchers have expressed the view that a market-driven approach is not enough to explain product innovation (Rosenberg, 1976; Tauber, 1979; Hayes and Abernathy, 1980; Nelson and Winter, 1982; Dosi, 1982; Johne and Snelson, 1988). The con-

clusion of Jones and Soelson's literature-based study is that market input alone is not capable of bringing about technological revolution.

The studies by Rosenberg and by Nelson and Winter assert that market information does not send a clear enough message to lead technological innovation. They instead propose the twin concepts of "technological imperative" and "natural trajectory" to describe the progress of technology through self-innovation. Furthermore, Dosi (1982) expands the notion of "technological trajectory" based on the model put forward by Kuhn (1962).

Dosi begins by pointing out that many empirical studies do not provide actual proof that the market is one of the determinants of innovation. He defines technology as "a set of pieces of knowledge" akin to science and asserts that "technology progress" is analogous to the Kuhnian definition of "normal science". In other words, given the existence of a technological paradigm that corresponds to the scientific paradigm, "technological trajectory" is defined as the "normal" problem solving patterns which constitute the basis for this paradigm: technology progresses along the technological trajectory. Therefore, the market is a "selecting device" for products, which are the outcome of a supply-side-oriented technology progress. Or, in Dosi's own words, "the supply-side determines the universe of possible modalities through which generic needs are satisfied".

Dosi's argument is clearly and logically laid out, and his work is the most comprehensive study available that advocates a technology-driven analysis. But to come back to the original problem of product innovation, there are three points on which our findings disagree with Dosi's conclusions.

The first divergence in our findings stems from Kuhn's model of scientific evolution as analogous to technological evolution. While the relationship between science and technology is a large and complex one, all of our interviewees (which included the heads of public research institutes and Nobel Prize candidates) were unanimous in stating that while the objective of science is to discover new natural phenomena or to invent new methods of explaining natural phenomena, technology is fundamentally an application; that is, its goal is to answer human needs. In other words, it is our view that in debating technological innovation, one must not lose sight of the importance of the market as a "selecting device", and therefore one cannot ignore the relevance of market evolution. On this point, the work of Clark (1985) has been extremely instructive, and we will touch upon it in the next section.

The second point on which we disagree with Dosi is that while the product developers we contacted were very aware of technology trajectory, this was by no means the only determinant for them. They were also extremely mindful of the progress of market needs, and in some cases it was those needs which provided the impetus for product innovation.

The third and final problem we found with the existing literature was that, focusing on product innovation, it merely accepted the notion of evolution without seeking to explain how innovation occurs (or is brought about). Though as Dosi points out, "A crucial question relates to how an established technological paradigm emerged in the first place", he does not provide any clear explanation, nor does Kuhn treat this in any detail.

But Dosi's work proved extremely valuable in informing our hypothesis that product innovation begins with the creation of product concepts. Restated, a "product concept" is a "product paradigm". If we interpret product innovation this way, we can adopt Dosi's notion of "technological trajectory" and rename it "product trajectory".

Also, this question of technology-driven or market-driven innovation appears to be one of serious and widespread concern among marketing strategy researchers (Firat et al., 1987; Sheth et al., 1988; Ishii, 1993; Ishii and Ishihara, 1996). A gulf has opened up between marketing researchers, who have split into two groups: those that focus on "consumer behavior" and those that focus on "marketing and management". Ishii, as one of those pursing a consumer-behavior oriented approach, has concentrated his efforts on developing methods for gathering actual market and consumer data, and in refining existing models and developing new models based on such data. Meanwhile, marketing and management studies have drifted into the area of management organization theory and marketing strategy theory, quoting freely from management literature. As a result, marketing research itself is losing its separate identity.

As one can see from the preceding discussion, the dichotomy between supplier-driven and market-driven is at the core of the debate over technology-driven versus market-driven innovation. We feel that in studying modern corporations it is necessary to get beyond such a bipolar discussion.

2.2. Conceptual progress of technology–market linkage

In a report based on a study of post-1980 economic literature, Johne and Snelson (1988) concluded: "Truly successful product innovators ensure the interplay and balance between highly skilled marketing inputs and highly skilled technical inputs". The first significant study to treat this question of "technology–market linkage", or "technology–market interaction", was done by Clark (1985). Clark argued that the pattern of innovation does not depend entirely upon product technology but is also influenced by "the interaction between the internal logic of the product and the evolution of customer requirements". Therefore, "uncertainty about technology

and customer preference" which characterizes the initial stage of innovation is what encourages product evolution. So, while technology becomes increasingly more advanced and consumers start buying and using the products that are the fruits of this technology, their needs also become more "specific and rigid". Furthermore, Clark identified a phase that follows innovation, during which no new innovations occur but rather advances are focused on "the refinement of existing designs". He called this process "the transition from 'architectural' phase to 'regular' phase."

This notion is an extrapolation—into the field of technology–market interaction—of Dosi's 1982 articulation of "technology trajectory", which was based on an analogical application of the Kuhnian Model. Our study was able to confirm the occurrence of this phenomenon. In other words, we observed that following the development of a new product, product innovators are constantly gathering information on consumers' reactions and carrying out further design and technology refinements in order to make the product better fit customers' use-requirements.

That said, our research focused on the following two points: (1) What is the output of supplier–market interaction at the time of innovation? and (2) How is that outcome created? We will take up (1) in the discussion below, while (2) will be described in the next section.

Crawford first introduced the idea of "protocol" in regard to the conflicts and disputes that erupt between R&D and marketing operations within one company, leading to the delayed release of new products, increased costs, and a failure to realize profits. Crawford (1984) defined protocol as an "agreement" that lists the benefits to be delivered by the product and its performance specifications.

Clark and Fujimoto (1991), in their research on the automotive industry, and specifically Honda Motors, discovered the importance of product integrity as a product concept; that is: the degree to which a product reflects the values and lifestyles of average consumers, above and beyond its actual functionality. Further, they found that product integrity has both an internal and an external dimension. The internal integrity is "the consistency between a product's function and its structure", while the external integrity is "the consistency between a product's performance and customer's expectations". They concluded that external integrity is still a much underexploited opportunity.

Moreover, Kodama (1995) proposed the concept of "demand articulation" in regard to technological innovation in the high-tech age. According to his theory, innovation is not so much a matter of resolving technological bottlenecks as it is figuring out how to use existing and available technology most effectively. That is to say, technology fusion is more important than technology breakthroughs. Demand articulation is thus the "technological expression of latent demand", which has two complementary components: an integrated approach, in which latent demand is translated into a single product concept, and a "deconstructed" approach, in which separate technological elements are developed individually.

When these three studies were integrated and examined together, we were able to see the connection between our own findings and the conceptual development across this spectrum of research. That is to say, the outcome of supplier–market interaction has progressed from protocol ("agreement") to integrity to articulation. At the root of this conceptual development is a close bonding, or fusion, between technology and market needs. In other words, we would like to propose that it is time to leave behind any approach that supposes a dichotomy, or polarization, between technology and market needs. We observed just such an attempt to combine technology and market needs in our case studies of successful product innovators in Japan. That said, when market needs are clearly articulated, it is a relatively simple matter to translate those needs into technological development with a stress on product performance. However, the problem becomes trickier when there are no clearly articulated needs; that is, when only "tacit needs" exist. In such cases, the mediation of market research and supplier–market linkage has little effect in helping product developers to gain a first-hand understanding of their potential customers and to create a product which they will want to buy.

3. Conceptualization

3.1. Conceptual framework of product innovation

The goal of product innovation is to ensure that one's company continues to survive and grow. To that end, one must follow two separate strategies simultaneously.

The first of these is to create new market demand so that one's innovative products will be well-received by consumers. To accomplish this, one needs to have an intimate understanding of the market, and use that to effect a change for the better in the lifestyles and use-systems of one's customers. This conclusion is supported by statements made by the interviewees in our study, such as: "As we develop a new product, we try to imagine how it will be used".

However, in the past market needs have been self-evident as consumers were very aware of what they wanted. They were able to articulate their needs. Hence, product innovators easily were able to study the market and understand demand. But recently, many consumers have become unable to articulate their needs. In such a situation, we say that the market contains "latent demand". It is unlikely that innovators will be able grasp

the state of market needs through consumer surveys. Some better way of perceiving the needs of the market must be found. The product innovators in our survey stated that, in creating an entirely original product, "It's no good to ask about market demand for something that doesn't as yet exist", "Demand is created when consumers see something for the very first time and realize that they want to have it". Such is the importance placed on what developers call "market insight".

The second strategy we observed was the building of obstacles to prevent one's competitors from easily duplicating the success of one's own innovations. This is the key to realizing profits. This role has fallen mainly to engineers, who are charged with coming up with technology that either cannot be imitated or else would take so long to duplicate as to discourage competition. According to our interviews, a 2–3 year advance in technology is required to create such barriers to competition.

Hence, we can categorize various product development strategies by placing them within a two-dimensional framework which consists of a horizontal dimension ("market insight") and a vertical dimension ("technological innovation"). Further, if we classify market insight as being either "deep" or "shallow" and technological innovation as either "incremental" or "radical", then we can plot product development strategies according to these four quadrants on our graph, as illustrated in Fig. 2.

For example, let's look at the quadrant at bottom right in Fig. 2 in which companies demonstrate "deep" market insight but only "incremental" technological innovation. Initial market reception of new products will be extremely positive and show strong growth, but this will be followed in a relatively short frame of type by competitors who imitate the product and either steal away market share or else force down the market price through competition, cutting into profits. we can call such an approach "market-driven". This strategy was prevalent in Japan up until the mid-1980s. An all-too-familiar pattern was that first-mover companies such as Sony and Sharp would come out with new products, only to have them quickly copied by powerful competitors such as Matsushita. In the sense that Sony and Sharp were in this way used unwittingly as market testers for the success or failure of new products, they came to be called "guinea pigs".

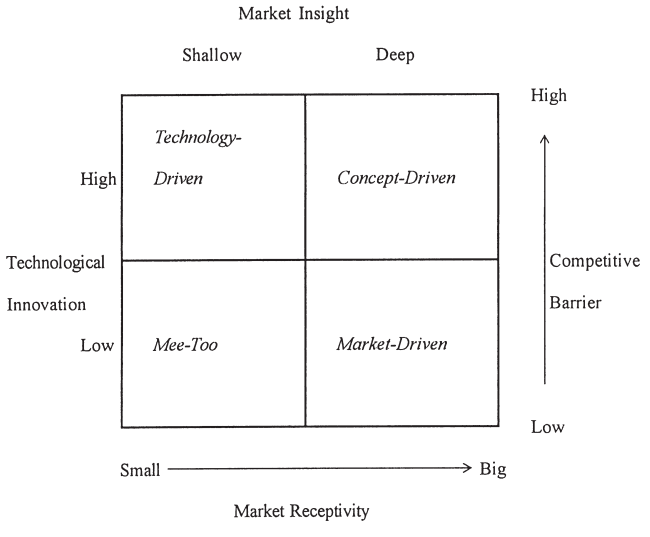

Fig. 2. Conceptual framework of product innovation.

In contrast, companies in the quadrant at top left possess a high level of technological innovation, making it difficult for their competitors to imitate their products. Hence, they enjoy great initial profits when products are first released. However, these products do not have much staying power with the "selecting device" of the marketplace, and they soon disappear. Such a strategy can be defined as a "technology-driven" one. In Japan, many parts manufacturers fall into this category. They possess a high level of original technology which they have refined in order to satisfy the requirements of the assemblers whom they supply. The assembler transfers market demand to them, and for this reason such suppliers are termed "order industries". Many venture enterprises in Silicon Valley are of this type. They are driven more by the race for technological innovation than by market needs. Hence, many of these companies fail if their technologies are not "selected" by the market. Moreover, in preliminary research, we found that many companies possess highly sophisticated technology that they are unable to translate into marketable products. We observed that such companies lacked product concepts with which to integrate their technology.

The lower left quadrant represents an imitative, or "Me-Too" product development strategy. Product developers in this category focus on what their competitors are doing and demonstrate little original market insight, hardly ever developing their own original technology. Instead, they attempt to erect barriers to competition through their system of distribution. Examples of companies that follow such a strategy include Sony and Sharp Electronics' rival, Matsushita Electronics, as well as the case study already mentioned, Asahi Breweries' competitor Kinin. However, such attempts to suppress competition through sheer force of sales and distribution networks are proving increasingly less fruitful.

The ideal product development strategy is the one in the top right corner of the graph. That is to say, product developers in this category demonstrate deep market insight, giving their products high market receptivity, and their potential for opening up new market needs is great. In other words, they have a high growth potential. At the same time, they are able to place technological barriers between themselves and their competitors, insulating themselves from the danger of being quickly swept up in price-gouging competitions and ensuring them-

selves high profits. All of the companies taken up in this series of case studies fall into this category.

Furthermore, the approach taken by such companies does not enter into the dialectic between market-driven and technology-driven development strategies. The progression of past research, both theoretical and empirical, suggests the need for a fusion between demand-side and supply-side economic analyses, or at least a recognition of their reciprocal relationship. Our research also concluded that the approach taken by leading enterprises is neither market-driven nor technology-driven. For example, the president of Kao, an innovative maker of household products, stated definitively, "Market needs are not something you understand through market research, they're created by innovative concepts". In other words, he is not a supporter of a market-driven approach. On the other hand, the leader of Canon's LBP development team stressed that "technological innovations are made in order to give product concepts actual substance". That is to say, his assertion is that product innovation is not the only factor in technological innovation. What both interviewees agree on, however, is that product innovation is led by product-concepts. For this reason, we named the competitive strategy in the top right corner of Fig. 2 a "Concept-Driven" approach.

Product concept is not merely a matter of linkage between technology and market needs, nor a simple reciprocal relationship between engineers and marketers. Rather, product concept is the "value" or "signification" that crystallizes, or emerges, from the interplay between suppliers and the institutional system of the market. They are not created by some agreement between engineers and marketers. (The term "institutions", in the sense that it is used here, has been defined by North (1994) as follows: "[T]he humanly devised constraints that structure human interaction. They are made up of formal constraints—e.g., rules, laws, constitutions—and informal constraints—e.g., norms of behavior, conventions, self-imposed codes of conduct, and their enforcement characteristics. Together they define the incentive structure of societies and specifically economies.")

Products are simultaneously both "induced" by the institutional system and in turn affect and change it (Watanabe and Clark, 1991; Watanabe and Honda, 1992). Product concepts are what drive this "virtuous spin cycle". At first, product concepts are induced by institutional trajectory. For example, what induced Asahi Breweries' concept for a new-tasting beer was the affect that Western foods had had on the Japanese diet. Likewise, Fuji Photo Film's concept for their Quick Snap disposable cameras was induced by the Japanese trend toward increasing miniaturization. Moreover, as new products become institutionalized, the latent needs of the market are brought to the surface, requiring product concept specifications to be more refined, and making the realization of those concepts more rigorous. On the other hand, the technological trajectory can have the same effect. For example, in the case of Canon's LBP, advancements in laser technology encouraged the conceptualization of smaller and less expensive products. Moreover, it was not the LBP that encouraged these concepts, but rather the Compact Disc player with its huge volume of production (see the learning-curve effect by the CD player to the Laser Diode shown in Fig. 3).

Finally, product concepts are usually articulated in a number of different ways which are gradually combined into one consistent idea. The process takes place as a result of a fusion between the expectations of the market and a product's performance.

3.2. The function of product concepts

What exactly is the role, or function, that product concept plays in forming the basis for product development?

The number one function of product concept is "integrity". In this regard, the findings of our study coincide with the assertions of Clark and Fujimoto (1990). However, while their notion of internal and external integrity is easy enough to understand, it is still predicated by the dialectic of supplier versus the market. We feel that it is time to take the notion of integrity beyond this bipolar framework.

For example, at the core of Canon's Quick Snap—"film with a lens attached"—concept were not just the structural and functional elements of disposability and high-quality pictures. It also embodied user expectations that such a product would be far less expensive than a camera and still have comparable versatility.

In other words, integrity is not just about the combination of technologies inside a product, nor about the fit between product performance and user expectations, but

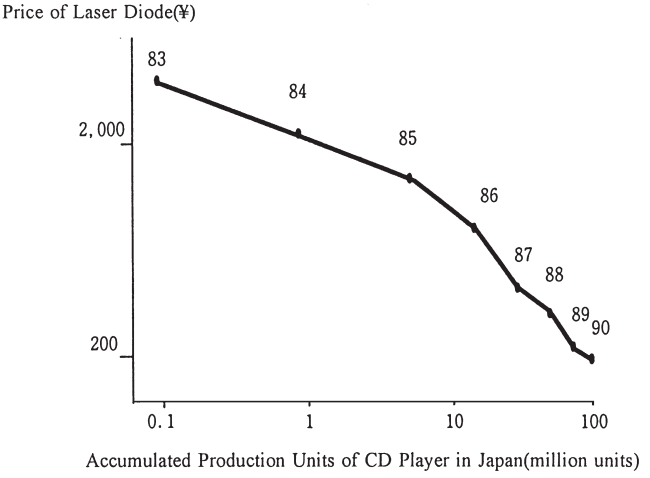

Fig. 3. Learning-curve effect of laser diode (1983–1990). Source: Shibata, T. (Sony Corporation) The formation of strategy to integrate hardware and software business: cross integrational strategy in the audio visual industry, *Organizational Science*, Vol. 26, No. 2, (1992) p. 87.

rather about the free integration of both of these dimensions.

Our study found that the second most important function of product concept is in bringing about product innovation; in other words, the "innovation initiative/drive" function. The successful product innovation companies in our study always began first with the development of a product concept. Product concept is equivalent to "product paradigm" in the Kuhnian model, and innovation is a "paradigm shift". In other words, innovation begins with the construction of a new paradigm.

Regardless of whether one is talking about a mature industry or a minor product, innovation always begins with the creation of a new concept. For example, in the case of Canon's Quick Snap, the concepts for "camera" and "film" already existed, of course. But beyond merely combining these concepts, Fuji created a new concept that turned "possession value" into "use value". (Fuji Photo Film considers Quick Snap to be a new film concept.) To give another example, Takara, a mature company that has been manufacturing liquor for hundreds of years, is known for the frequency with which it creates product innovations (roughly every seven years). Its most recent innovation is a new kind of Japanese sake, called "Baisho-Zukuri" which was born from the concept of "a smooth tasting wine what doesn't make your breath smell of alcohol". Though the brewing of sake in Japan has a long history, no one had ever thought of developing a product along these lines. In the same way, Nintendo was once just a long-established maker of playing cards and other games until it innovated electronic video games.

The functions described above in turn beget other functions, but here we will stick to discussing just the direct functions of product concept. The third function is that of defining technology development goals. The product concept contains an implicit message about performance expectations, which must be translated into technical requirements. If those requirements can be met by existing technology, then the concept will be immediately realized, sometimes by creating new combinations or "fusions" of existing technologies. But if even one aspect of the concept cannot be answered by existing technologies, then a new technology, or a technological breakthrough, becomes necessary.

For example, let's again look at Fuji's Quick Snap. In order to deliver the concept of "high-quality pictures" the company needed a breakthrough in highly sensitive, high-quality film.

Likewise, the concept behind Canon's LBP required a new laser technology that could print rapidly without making holes in the photosensitive drum. And Asahi Breweries' new flavor-concept for its Super-Dry beer, containing two opposite taste elements, was only made possible by the invention of two new types of yeast, #508 and #318. Finally, Takara's Baisho-Zukuri necessitated the removal of fat and amino acids, which was impossible given the traditional "steaming" method of brewing sake from rice. In consultation with their brewing machinery manufacturer, Takara made a breakthrough called "hot-air treatment".

The fourth function of product concept is to give definition to marketing strategies. Product concepts encapsulate messages about market needs, which become selling points for the new product. Furthermore, innovative products are usually given the three trials before they enter mass production, during which time these selling-points can be refined. The important point here is that rather than using the test results to strengthen any weak points which may become evident, product innovators choose to focus on strengthening, or "sharpening", the product's selling points.

For example, initial testing of Quick Snap revealed that consumers were impressed less by the product's "convenience of use" than by its "high-quality pictures". As a result, the development team at Fuji Photo Film instructed their engineers to work on developing even better film while simultaneously focusing their advertising campaign on the "high-quality pictures" selling point. Similarly, Sony decided to adopt the key word "passport-size" in the marketing of its revolutionary video camera, which, like Sony's other products, was based on the traditional product paradigm of miniaturization. And Asahi defied a beer-industry taboo against tampering with flavor, choosing to make freshness and taste the center of its advertising strategy. They even went so far as to recall products after a set period of time—another industry first—despite the increased distribution costs this entailed.

In this way, we can see that when products are developed and sold successfully, it is because they have a consistent and clear logic. In other words, highly successful products are based on a "theory". Product success is based upon performance, which depends upon the degree to which the product systematically and logically addresses both consumer needs and the institutional framework of the market, and upon how skillfully the product concept has been translated into the language of technology.

3.3. Process and management

The concept-led product development process typically consists of four phases: (1) market "insight", or inferences, (2) product-concept construction, (3) concept realization, and (4) mock-up testing, or market-needs verification.

Market insight is a matter of how well developers express, on behalf of customers or users, "tacit" market needs. We were able to identify the following three methods of achieving market insight in the case of con-

sumer products. The first is to estimate the direction that lifestyle changes will take in the near future and based on that, to make inferences about latent needs or, related to this, to change an existing product concept when it has been observed that a lifestyle change is affecting present needs. Out of a sense of crisis, the developer may choose to sustain, or fuel, those present needs which sustain his company. For example, in the previous example of Asahi's Super-Dry, the developers began creating their concept after noticing the following trends: an increase in the quantity of oily foods being consumed, an increase in female beer consumers, and a greater tendency to drink at home rather than in bars and restaurants. Likewise, Fuji Photo Film began discussing ways to increase consumer desire once it realized that Japan's declining birthrate—leading to fewer children and fewer reasons to take pictures—was causing film sales to slump . . . and the Quick Snap was born!

Understanding and estimating consumers' lifestyle changes is an essential condition for achieving market insight. Another method which we identified for understanding latent needs even more clearly is to establish direct contact with one's target consumers. At this stage, consumers are unable to articulate their needs; that is, they only have a "tacit knowledge" of their needs. Nonaka and Takeuchi (1995) have labeled this method "socialization" and "emphatic", respectively. Also, Normann and Ramirez (1993, 1994) have studied methods for having consumers participate in the product development process in order to bring latent needs to the surface.

Normally, developers do not conduct market surveys in order to measure market needs because, as many of our interviewees stated, consumers cannot express a need for something that does not yet exist. However, sophisticated testing such as that which Asahi conducted is fairly common. The developers asked consumers to take a blind taste test of a number of beer flavors and from the results estimated a taste "trend". But at best, such tests can only provide hints for developing a product concept. Asahi's developers also carefully analyzed lifestyle trends.

The second phase of the product development process, constructing a product concept, is a matter of identifying "signification" buried within the hypothetical or estimated latent needs. A product concept is usually expressed in a number of different ways that both capture emotionally the lifestyle values of the consumer, and express logically the functions of the product that will help realize those values.

The third phase, realizing the product concept—or giving physical form to the idea behind the product—involves clarifying the product specifications and concretely defining what existing technology will be employed, beginning development of any new technology that is needed.

Finally, the fourth phase, market testing, is needed to measure consumers' reaction to a product prototype. Any discrepancy between the developers' intentions and consumers' reactions much be corrected at this stage. Typically, product prototypes go through three series of testing and modification before final production is launched. Here we would like to stress that during modification, the product's selling-points are given further technological refinement.

These four phases do not occur successively but rather overlap, as developers return to one phase or jump ahead to another.

As many studies have pointed out, a cross-functional approach within an organization is highly effective in new product development (Clark and Fujimoto, 1990; Dougherty, 1992; Manz and Sims, 1995; Iansiti, 1995; Ottum and Moore, 1997). But the notion of cross-functionality presented in these studies is predicated upon Barnard's definition of a formal organization that performs "routine work". In other words, if one adheres to the paradigm of Barnard (1938) we must recognize that product development teams are informal organizations. Now, the question which we must address is how is an informal organization whose goal is to develop a new product formed: and how does it overlap with a formal organization?

First, our findings suggest that there are various models for creating such organizations, ranging from Fuji Photo Film's naturally-occurring development team to Sharp's and Sony's top-management-appointed, "formally-sanctioned" informal grouping. Yet each kind of informal organization has several points in common. First, their main function is to develop a new product concept. Second, they are not made up only of engineers. Third, they are not operated according to a traditional management structure.

Formal organizations have what are called "organizational barriers". These barriers takes various forms, be they the boundaries between different fields of work, various managers' spheres of authority, or the psychological commitment of workers to a specific job function. Therefore, for a cross-functional, informal organization to form naturally, the team members have to have the will and the enthusiasm to overcome these organizational barriers. Hence, it is a matters of the members' own initiative. Moreover, the organization barriers are strongest between research and management operations. Dougherty (1992) has shown that these barriers are the result of different "interpretive schemes" of groups within the organization. A special effort—typically on the part of top leadership—is necessary to break through these barriers.

Our findings support this conclusion. In the case of Fuji Photo Film's concept development team, one individual (from a non-technical field) took the initiative of informally sounding out people in other fields, and one by one members were induced to join the team. But all

contact with the research members of the team was conducted on an official basis. At Sharp, the top leadership was involved in placing researchers on the development team from the very beginning. At Asahi, again top leadership was instrumental in calling for a major breakdown of organization barriers which eventually led to the development of the company's revolutionary beer.

Once the cross-functional development team is formed, a "field" for creating a new concept is put in place. This notion of "field" is based on the model proposed by Nishida in the 1920s which drew on the work of the philosopher Heidegger. That is, when individuals are gathered together, their interaction creates a "field" which subsumes the independent "subjectivity" of each individual. This subordination to the "field" creates a form of "objectivity". In other words, the "field" itself is autonomous and self-organizing (Itami, 1992). For example, one of the interviewees in our study said, "At the beginning, people just express their own opinions and ideas. But the more they listen to other people and try to respond, the more interested they get. They start to have ideas that they couldn't have come up with on their own. As it progresses, the field starts to take on its own perspective, and everyone is influenced by it. In other words, the opinions expressed are no longer their opinions, but the opinions of the field. All sorts of ideas appear that no one individual could have produced on their own".

The concept of "field", then, is the idea of "cross-functional communication" taken one step further. It enables the team to demonstrate greater unity, trust among members, and sharing of information. It is a creative collaboration that causes ideas to emerge (Manz and Sims, 1995; Bennis and Biederman, 1997). Each of the four phases of the product development process constitutes its own "field": a market insight field, product concept construction field, concept realization field, and market needs verification field. As we have already stated, these fields overlap (a team member can belong to more than one field). Fig. 4 illustrates this principle.

Typically, one individual, or leader, oversees the entire 4-field process. Though the leader is in charge of managing time and financial resources, he/she does not control the other members. Furthermore, the leader goes beyond the role of merely coordinating or facilitating functional communication between the organizational units. He/she is like a movie producer, acting as a catalyst for interaction between team members. In other words, the "field" model of leadership is quite different from the traditional coordinator, or "command-and-control"-style leadership of the past.

One can also say that the "field" is an ontological mapping of the product concept. In the real world, the product concept is composed of several interlocking and self-adjusting phases. In this way, the product concept is the sum total of several consistent composite elements

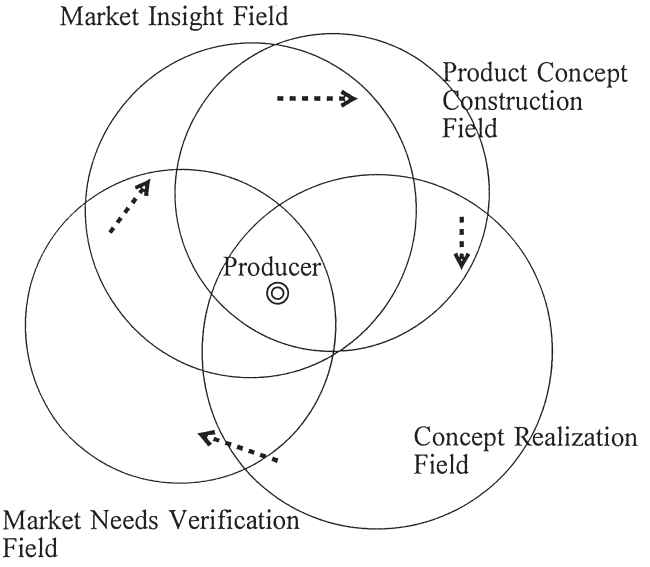

Fig. 4. Product development fields.

(Deleuze and Guattari, 1991). While on one hand, the "field" is made up of individual members each with his/her own expertise, when interaction is sparked, it takes on a unified consistency. In other words, although both product concept and "field" surpass the level of individuality and achieve a wholeness, they differ in that concept is an epistemological entity and field is an ontological one.

4. Discussion

It must be pointed out that the concept-driven product innovation hypothesis proposed here is merely a deductive model based upon a limited observation of successful Japanese corporations. As a result, we can as yet make no claims as to its being universally applicable. Further and more extensive research is needed on a number of key issues.

We can identify at least three issues that need to be addressed by further research: (1) Gaining greater insight into the question of "What exactly is a product concept?" (2) Analyzing the relationship and the dynamics between the product concept and "institutions" (consumer lifestyles, social systems, etc.). (3) Explicating the process of concept-driven product innovation based upon an understanding of the above two issues.

According to our research, this concept-driven methodology seems to have first appeared in Japan in the 1980s. We can propose three possible explanations for its emergence. First of all, the marketplace had become so flooded with products that consumers became unable to express their own desires. Hence, faced with these latent market needs, suppliers found themselves unable to translate the needs directly to the product specifi-

cations. Second, the inevitable increase in competition for product innovation that resulted forced companies to rely on technology in order to erect competitive barriers to protect themselves, while at the same time trying to guess what consumers wanted and to respond accordingly. Third, technological innovation and the ability to reflect market needs became the two most important determinants of a company's success. This, according to our findings, is how concept-driven product development came about in Japan.

Accordingly, the present research is predicated upon the observation that product concepts, first and foremost, are born from a dialectic between technology and the market—that is to say, from the interaction between engineers and marketers. Therefore, we would like to propose the notion that products are not simply the "lump sum of their component technologies". In other words, the question "What is a product concept?" is the same as "What is a product?" At the very least, what we have learned from the case studies we conducted is that a product is made up of certain values, or significance, that result from its being used. Many of the interviewees from the Japanese companies in our study told us, "When we think of a product concept we try to imagine how the consumer will use the product". In other words, a product acquires a specific value or significance only when it is used or consumed. Thus, we can tentatively define product concept as the creation of value and significance that begins with the process of making deductions based on an awareness of consumer needs. The testing of this hypothesis comes under the first issue which we have identified for further research.

In regard to the second issue, the traditional approach to product innovation, especially with respect to radical innovation, has been that individual creativity results in technological innovation which is then acted upon by the selecting devices of the marketplace. But according to our findings, Fuji Photo Film's Quick Snap camera, for example, was born primarily in response to a sense of crisis in the film industry brought on by Japan's declining birthrate and a corresponding trend among consumers to use less film. Likewise, Asahi's Super Dry beer came about because it was thought that the Westernization of the Japanese diet had made existing beers unsuited to current tastes. Furthermore, Canon's Desk Top Laser Beam Printer was a response to the fact that while the amount of office equipment was steadily increasing, existing printers were inadequate because they were slow, noisy and didn't print very clearly. In other words, what our findings seem to suggest is that revolutionary product concepts are induced by the institutional system of the market. If that is the case, then it follows that as the institutional system evolves product concepts must also change to keep up—that is to say, the interaction between institutional inducement and product concepts is a dynamic one. But how exactly does this mechanism work? The elucidation of that point is the second issue for further research.

The answers to the above two issues will serve as the basis for probing the third issue of what constitutes the best way to undertake and manage the process of concept development. In effect, this third issue relates directly to the very question of how to effect product innovation.

The present study has reported findings which demonstrate that in the best performing companies the following process: ⟨Perceiving market needs→Creating a product concept→Giving substance to the concept→Testing a prototype→Making improvements⟩ takes place within the "field" formed by an alliance of engineers and marketers. This provides some very useful suggestions for future research on product innovation. However, there is still need for greater clarification of the question of the managerial aspect of this process: What specific measures should companies take? What sort of leadership should management provide? The answers to these questions will shed further light on how product innovation occurs.

We believe that research into these three key issues will prove extremely helpful in reaching a better understanding of the significance of product innovation.

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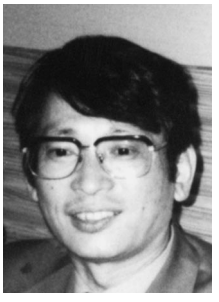

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