Learning by doing in the development of new products.

Real-time Market Research

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New products have long provided the vitality that characterizes flourishing companies. In the past few years, however, important changes both in the nature of consumer demand for new products and the means available to firms to serve that demand have made new product development the central arena of competition in a growing number of product markets (Clark and Fujimoto, 1991). On the demand side, these new dynamic markets are characterized by growing consumer sophistication, intensifying market segmentation, and increasingly rapid shifts in consumer preferences as firms scramble to provide a growing range of product choices of escalating performance and expanding functionality. On the supply side, some firms have begun to make strategic use of accelerated product development techniques, flexible manufacturing systems and, as we suggest here, new product design regimes to practise a radically new form of market research which we have termed "real-time market research".

In real-time market research, firms bypass most traditional market research approaches (and their limitations and time requirements) to offer batches of actual new product models to consumers to learn their exact and varied preferences as to alternative product configurations, features, and performance levels. Streamlined product development, flexible manufacturing, and new product design regimes, which together permit rapid, low-cost proliferation of product variety make this new approach to market research feasible and economic.

In this article, we first discuss the traditional decision support models used in new product market research, highlighting their inherent limitations. We then briefly summarize the ways in which increasing dynamism of product markets has accentuated the importance of accelerated product development and flexible manufacturing. We then suggest that the highly dynamic nature of some product markets has led some firms to develop new product design regimes which permit the rapid, low-cost proliferation of product variations and improvements. We suggest that those firms that can successfully mesh these new product design regimes with rapid product development and flexible manufacturing capabilities can economically undertake real-time market research – and thereby overcome the inherent limitations of traditional market research methods. We then discuss the new product design regimes on which real-time marketing is based. We give empirical evidence of the existence, practicality, and effectiveness of real-time market research by documenting examples of the successful use of the new product design regimes in dynamic markets, and we use these examples to illustrate the new product design regimes which enable a firm to engage in real-time market research. We conclude by noting that the market success achieved by firms using real-time market research suggests that this skill is a critical strategic capability essential for competitive success in dynamic markets.

Limitations of Traditional Models

This section provides a brief summary of the major traditional models used in market research to provide decision support in new product development. We highlight the inherent limitations of these models in conducting market research in dynamic markets.

Two recent studies summarize the traditional methodology followed in managing the new product development process. Cooper and Kleinschmidt (1986) report a study of 252 new product introductions, and Mahajan and Wind (1991) report a survey of 69 firms. Mahajan and Wind reported their findings of the "fit" between the various activities undertaken in new product development and the analytic models provided by the traditional methodology of market research. In Table I, we summarize Mahajan and Wind's findings as to the limitations of the models on which the traditional methodology is founded. In spite of the limitations suggested in Table I, the managers surveyed by Mahajan and Wind identified "improving the success rate of new products" as the most important motivation for attempting to use traditional market research models.

Table I. *Limitations of Traditional Market Research Models*

Models	Major shortcomings
Focus group	Market complexity not captured
Limited rollout	Too much time to implement
Concept tests	Forecast inaccuracy
Show test/clinic	Too much time to implement
Attitude, usage studies	Forecast inaccuracy
Conjoint analysis	Expensive; complexity not captured
Delphi panel	Market complexity not captured
QFD	Forecast inaccuracy; too much time
Home usage test	Expensive; too much time
Product life-cycle models	Forecast inaccuracy
Synectics	Expensive, forecast inaccuracy

The overriding interest of managers in improving the success rate of new products is not surprising given the results of a 1984 study by the Association of National Advertisers which found a 46 per cent failure rate for new products introduced in product categories in which the firm had no prior brands. The same study also found a 31 per cent failure rate in product categories in which the firm had existing brands.

The Mahajan and Wind survey also makes clear that forecasting inaccuracies, up to and including the time of actual implementation of the new product development process, continue to plague new product development managers. Thus, in spite of the growth of the simulated test market industry to $40 million in annual billings, and in spite of considerable advances in the development of analytic models in the academic literature, there is still much to be desired in the ability of traditional market research models to tell product development managers how well a given new product will fare in the marketplace. Future improvements in market research also need to address the growing complexity and multi-dimensionality of the product development decision. Among the issues which market research models will have to address are a host of pressures associated with the increasingly dynamic nature of a growing number of product markets: the need to achieve continuing customer satisfaction, the globalization of product markets, the narrowing of the window of opportunity to introduce new products successfully, the accelerating pace of change both in product and process technologies, the increasing sophistication of consumers, and consumers' growing insistence on products more closely matched to their particular needs.

PIMS studies also indicate the importance of overall product market share in achieving sustainable profitability within a given product market (Buzzell and Gale, 1987). Studies by Urban *et al.* (1986), Robinson (1988) and Kalynaraman and Urban (1990) provide considerable evidence that the gains to first movers and early entrants can be significant. If a product development manager contemplates the potential for profitability for early movers who manage to achieve large market share, and at the same time considers the uncertainties that are likely to exist as to exact consumer preferences, the likelihood that able competitors will enter quickly, and the potential economies of scale or scope that may be obtainable by offering a broad product line, it should not be surprising that many new product introductions are approaching the market not just with a single product, but with a broad product line. The product line approach increases the possibility of serving multiple need segments, of collecting price premiums in each segment well served, of building greater market share in the product category, of achieving cost efficiencies, and, ultimately, of increasing the odds of a successful product launch. This product line approach to product introductions is supported by an analytical study by Sudharshan *et al.* (1988) which shows that simultaneously identified new product introductions may be superior to sequentially identified ones.

Some firms have abandoned traditional methods for researching markets

The simple relationship between the probability of success and the number of new products introduced also supports the introduction of broad product lines. If two versions of a new product, say, A and B, are introduced, the probability that one of the two will be successful will always be greater than the probability that A alone or B alone will succeed, as long as demand for A and demand for B are not perfectly correlated. Introductions of multiple new models within a product line thus lead to higher probabilities of initial success and eventual large market share. For these reasons, it is not entirely surprising that some firms have largely abandoned traditional methods for researching markets and, instead, have invested in learning how to develop more products more quickly and cheaply in order to test the market in "real-time" with a range of real product models. The incentive to use real products to research markets is especially heightened when markets are dynamic in nature, as discussed in the next section.

Dynamic Markets and the Rise of Real-time Market Research

In recent years, the accelerating pace of technological change and the increasingly rapid shifting of consumer preferences have combined to create highly transitory – but potentially lucrative – windows of opportunity for firms in many product markets. Firms who have been first to identify appropriate new products made possible by new technological advances, or to realize new products incorporating existing technologies which appeal to newly evolved consumer preferences, have been able to reap substantial profits by establishing a dominant position in the new market before competitors enter the market and by exploiting to the maximum extent possible a new product type before technology advances obsolete the product or before market preferences shift to yet another product type.

Rapid product introduction alone does not resolve the uncertainty

The fleeting nature of today's windows of opportunity may work to the advantage of firms which have reduced their product development cycle times and which have developed flexible manufacturing systems that let them quickly move new products from concept to production. Speed in bringing new products to market, however, has not solved all the problems faced by the firm in competing in dynamic product markets. Rapid product introduction alone does not resolve the fundamental uncertainty as to the appropriateness of a new product in meeting consumer preferences, nor the risk inherent in the cost of developing new products which may subsequently prove unacceptable to consumers.

In recent years, a few firms in dynamic markets like consumer electronics products have pursued new product design regimes which allow them to proliferate a large number of variations on a basic product type quickly and at low incremental development cost for each new model. These firms have coupled this new product design regime to rapid product development capabilities and flexible manufacturing systems to introduce new product types at greatly reduced costs, to introduce in quick succession many versions of the new product type offering higher and higher performance levels, and/or to proliferate quickly multiple product models (at low incremental cost) which offer different combinations of features added to the basic product type.

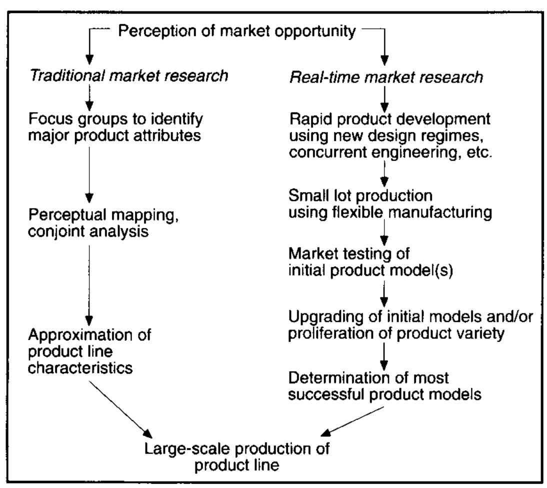
This joint design, development and manufacturing capability has enabled these firms to pursue a fundamentally new approach to market research that we have termed real-time market research, which is illustrated in Figure 1 and contrasted with the traditional market research method. Under this approach, a firm researches the market for a new product by actually producing batches (say, up to 10,000 units) of a new product model, of subsequent new models with higher performance levels, and/or of variations of the basic product incorporating different packages of features. These small lots of actual new products are offered to targeted markets. Instead of asking consumer focus groups to comment on potentially difficult-to-imagine variations on new product concepts, the real-time market researcher gives consumers real products to see and handle and lets consumers vote with their dollars to express their approval or disapproval for different variations of the product model. The firm then puts into mass production only those models to which consumers respond most enthusiastically. Thus in real-time market research, the firm can actually "learn by doing", i.e. by introducing real product models, instead of investing time and resources in imperfect forecasting and predictions.

The next section describes the product design regimes which, when coupled with accelerated product development and flexible manufacturing systems, make real time market research feasible. Then some cases are presented which illustrate how these product design regimes support real-time market research.

Product Design Regimes

This section will examine three product design regimes which form the basis for real-time market research (Sanchez, 1991). These new design regimes enable:

Figure 1. *Steps in Real-time Market Research Compared with Traditional Market Research*



(1) introduction of new product types with reduced development time and cost;
(2) rapid, low-cost upgrading of product performance levels;
(3) rapid, low-cost proliferation of product variety.

Introduction of New Product Types at Reduced Cost and Time for Development

In the development of assembled products as diverse as dishwashers, electronics products, and passenger aircraft, some firms have discovered that *componentizing* product designs can lead to reduced costs of development and manufacturing, as well as shortened new product development periods. Five variations of the componentized product design regime are summarized here:

(1) system design with "black box" component design by suppliers;
(2) design with "off-the-shelf" components;
(3) reuse of pre-existing components in new product designs;
(4) intentional use of parts commonality across a group of related products;
(5) initial design of components for reuseability.

The advantages of reduced development time and cost for initial and subsequent product models which can be obtained from these design regimes are substantial. However, these component design regimes do have some potential pitfalls, which are also noted.

System design with "black-box" development. In industries producing complex products which will be assembled from components sourced from many suppliers, a common engineering practice for many years has been to define a new product as a system design composed of well-defined components, the design and detailing of which is separable from other components in the product. Designing a complex product as a system of components requires that the designing firm define the attachment, power or load transfer, and control interfaces between components (Ulrich and Tung, 1991) and co-ordinate the overall design so that the final assembly of components will perform together and deliver the intended functions of the product. Once the desired functionality of the product has been decomposed into separable components, design and production of components by suppliers can proceed in parallel, thus accelerating the pace of product development.

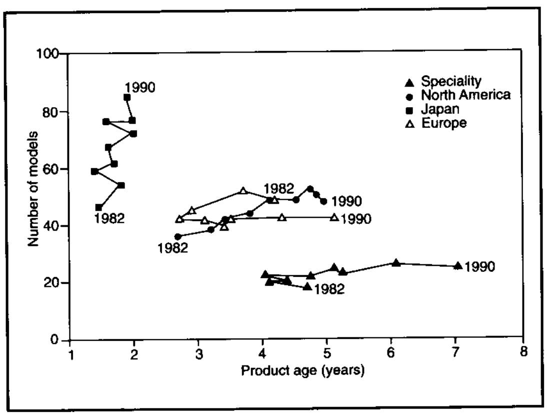
Japanese car makers have been notable in expanding the scope of product development which the firm can undertake by evolving a supplier-based approach to developing componentized system designs that has come to be known as the "black-box" approach to new product development. Originally constrained by limited engineering resources (which the car makers wisely focused on developing system design skills), Japanese car makers in the 1950s and 1960s shifted most responsibility for development of components to their suppliers (Clark and Fujimoto, 1991, p. 152). In developing new car models today, Japanese car makers typically provide their suppliers with only a "black-box" specification of the size and functionality of the required component and leave the actual design and development of the component up to the supplier.

Japanese manufacturers concentrate their limited resources on redesigns

Following this approach to component development allows Japanese car manufacturers to concentrate their limited engineering resources on frequent overall product redesigns, leading to shortened product development cycles and a resulting greater variety of product models introduced to the market. Figure 2 shows evidence of the success of Japanese car makers in shortening product development cycles and increasing the number of product models offered to consumers in the highly competitive car market (Womack *et al.,* 1991).

Design with "off-the-shelf" components. In many product markets, components manufacturers often offer a range of standard, "off-the-shelf" components which can readily be incorporated into a range of designs for new assembled products. Examples of such off-the-shelf

Figure 2. *Number of Car Models in Production and Average Age of Product Models for Japanese, US, and European Car Producers 1982 to 1990*



components range from hard disks for personal computers to shock absorbers for cars to cassette drives for tape decks. When a new product design can incorporate at least some off-the-shelf components, the total development cost for a new product can usually be reduced by using a standard component instead of designing a new component. Development time can also be shortened. The cost of manufacturing the new product can also be lowered if unit costs for an off-the-shelf component are less than those for a customer-designed component (which is often the case if the standard component is produced in large volume).

Although use of standard components may involve some compromise of overall product performance, the resulting development time and cost reductions and subsequent manufacturing costs savings can be substantial compared with the reduced value of the compromised performance of the assembled product. *The Economist* (1991) has suggested that extensive use of off-the-shelf components (which *The Economist* terms "catalogue design") by Japanese firms results in "a product that is 90 per cent as good as a product designed from scratch might be – but only half the price [cost] of a completely original version". Thus, skilful use of off-the-shelf components may substantially reduce the cost and time required for the development and introduction of a new product type.

Extensive reuse of existing parts lowers costs

Reuse of existing components. Development of a new version of an existing assembled product need not require redesign of every part or component used in the assembled product. Often at least some existing components in current models can be incorporated into a new model design. In the best cases, a product model's perceived functionality can be changed significantly by making changes in a relatively few components, allowing a substantial carryover of components from one product model to another. In the American automobile industry, for example, extensive reuse of existing parts lowers the costs of introducing "refreshed" or moderately redesigned models every two or three years between major product redesigns.

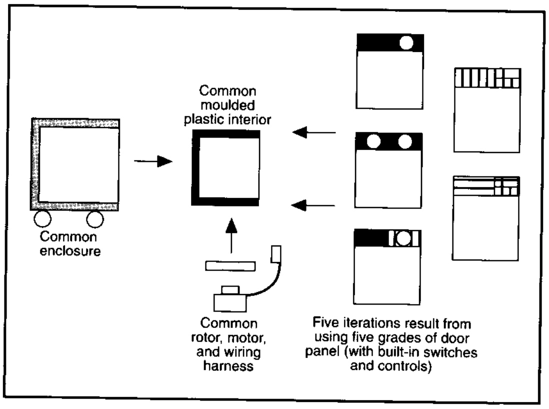
The potential benefits of reusing existing components are similar to those obtained by using off-the-shelf components: reduced development time and cost and/or lowered unit manufacturing costs, which in turn increase the economic feasibility of real-time market testing of new products, upgrades and variations.

Parts commonality. In some cases, an entire family of related new products may be designed which makes extensive use of common parts. A high level of parts commonality across product models can lower the costs of developing and manufacturing each new product model in the family. Two examples illustrate the use of parts commonality to reduce costs in development or manufacturing.

The development of airframes for commercial jets is engineering-intensive and can be both lengthy and expensive. To reduce the time and cost of developing new aircraft models, all major airframe builders now make extensive use of common parts and components in designing a family of related models of a new jet. For example, Boeing, McDonnell-Douglas and Airbus Industries all make use of wing, nose and tail designs which are shared across a family of aircraft, with product model differences usually achieved by variations in the length of fuselage and the thrust of engines fitted to the aircraft.

The use of parts commonality to reduce manufacturing costs as well as development costs can also be observed in General Electric Company's redesign of its dishwasher line to exploit the development and manufacturing economies of parts commonality. Figure 3 illustrates GE's use of parts commonality across a full range of models. By "containing" variety among product models to the dishwasher door panels (which contain the functional and decorative components needed to differentiate one model from another), GE can introduce new product models relatively quickly and at low cost by simply designing a new dishwasher door panel.

Figure 3. *Parts Commonality among General Electric Dishwasher Models*



When a high degree of parts commonality can be maintained between a potential new model or models and existing models, the time and cost of market testing a new product model can be reduced significantly.

Component design for reuseability. Certain kinds of assembled product may be able to incorporate modular components with relative ease and efficiency. In such cases, a firm may be able to develop an initial product design based on modular components with the intention of extensively reusing the modular components in many future products. The ability to incorporate components in future products reduces the costs and time required to develop and introduce additional new products or models.

Design of components for reuseability can be observed in product markets as diverse as farm equipment and computer software. Shirley (1990) has described the rationalization of product designs into "product sets" which make extensive use of components specially designed for reuse, such as hydraulic cylinders and transfer-gear cases in tractors and farm equipment. In computer software, Cusumano (1989) has documented the reduced time and cost to develop customized software programs achieved by the Japanese computer firm Toshiba as a result of writing program routines as modules which can be reused in future programs. In the Cusumano study, Toshiba was able to achieve as much as 80 per cent reuseability of modules in its new software, with substantial gains in productivity (i.e. a reduction in development or manufacturing costs/unit) and speed of program development.

Reuse of components can reduce the cost of introducing new models

Product design regimes based on intended reuse of components can reduce greatly the time and cost of introducing new product types or models to the market.

Some caveats. The foregoing discussion has discussed the time and cost advantages which can result from the successful application of the five component-based design regimes. Some potential pitfalls of these strategies also deserve mention.

Using an off-the-shelf, pre-existing, or shared component in a new product design may require some compromise of the performance obtained from the new product, at least when compared with the performance that could be obtained from a component designed exclusively for that product. A further danger is that overly extensive use of common components across product models could make it more difficult effectively to differentiate each product model from models which share the common components. (Perhaps the classic example of the loss of differentiation through extreme component commonality is the GM line of "X-cars" – Chevrolet, Citation, Oldsmobile Cutlass, Pontiac Phoenix and Buick Skylark – which had a very high degree of parts commonality, but which were virtually indistinguishable in appearance and, as a result, sold poorly overall because of inadequate differentiation across branded models.) Finally, repeated reuse of components in successive designs limits the opportunities to make incremental improvements to product models by upgrading components whenever a new product model is introduced.

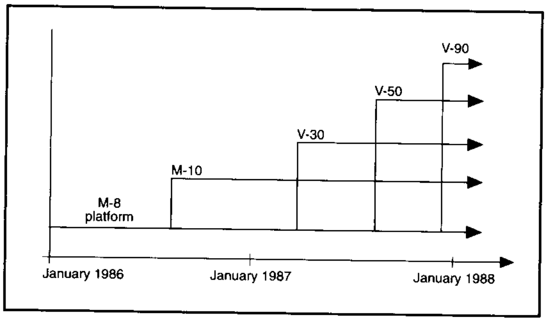
The effect of any of these potential pitfalls in component-based design regimes would be the development of a poor-performing or inadequately differentiated – thus, less competitive – new product which would be unlikely to succeed in the marketplace. Thus, to engage successfully in real-time market research, product designers must be able to capture the time and cost reductions achievable through component-based design regimes, while being careful to avoid diminishing the value of a new product design through inadequate performance or differentiation.

Rapid Product Upgrading

When a firm has an original idea, one way in which the firm may be able to capture as much benefit as possible from its original product idea is to introduce a quick succession of upgraded or otherwise improved product models soon after introducing the initial model. If the firm has the ability to develop improved versions of its product quickly, the firm may be able quickly to learn much about various consumer preferences with regard to its original new product – preferably before imitators can introduce their copycat versions the firm's introductory product.

In response to the significant improvement in market knowledge which can accrue to an innovating firm when it can rapidly test upgraded versions of its original product, some firms have developed a product design regime in which a product is intentionally designed as a platform for rapid product evolution. Sony Corporation – a firm which has a history of being first to market with original products like mini-TVs, compact disc players, and the 8mm cassette "HandyCam" video camera – has developed a high level of skill in designing new products as platforms which can be upgraded quickly to incorporate a range of possible improvements and features. This design regime defines a new product as a system design in which key components are slated for upgrading to enhance performance and functionalities as better technical capabilities are progressively incorporated into the key components.

Figure 4. *Evolution of Sony HandyCam Models from Original M-8 Platform Design*



The development of the Sony HandyCam video camera (Sanchez, 1991) illustrates how Sony conceived the original product design as a platform for rapid product upgrading and rapidly tested the market for upgraded versions of the HandyCam after introducing the original M-8 HandyCam platform design. Figure 4 shows the pattern of rapid product model evolution based on the M-8 platform design from 1985 to 1988. The original HandyCam M-8 model, introduced in January 1986, incorporated the platform design which defined the basic arrangement of the camera's components and specified the interfaces between its major functional subsystems and components. The M-10 model, introduced eight months after the M-8 in July 1986, incorporated a redesigned circuit board (to lower production costs) and a slightly different exterior case to distinguish it in appearance from the M-8. The M-10 was offered at a slightly lower price than the M-8. While the purpose of the M-10 was to offer a less expensive model to help Sony to penetrate the video camera market, the first significantly technologically upgraded product, named the V-30, was intended to test consumer demand for more sophisticated performance and functionality – and if accepted by the market, to maintain Sony's technological and market leadership – by offering significantly improved performance over the basic M-8 or M-10 models. Accordingly, the V-30 was elaborated on the original M-8 and M-10 platform by incorporating an electronic viewfinder, an autofocus zoom lens, and a videotape playback feature. To differentiate effectively the upgraded V-30 from the M-series of HandyCam cameras, the V-30 was packaged in a sleek new exterior case. However, the basic arrangement of the M-8 design, the definition of interfaces between its components, and a number of original components from the M-8 design were carried over on the V-30 model.

The upgraded performance of the V-30 met with considerable consumer approval, and an even more sophisticated HandyCam Model, the V-50, was introduced in October 1987, six months after the V-30. The V-50 incorporated three product features (an extended range zoom lens, a modification to the circuit board to allow a "picture insert" feature, and a more powerful battery pack) which were developed after Sony studied consumer reactions to the V-30 HandyCam.

The next model of the HandyCam, the V-90, was Sony's response to the consumer approval of the V-50 and to consumers' strong appetite for increasingly sophisticated features and performance capabilities which Sony discovered in marketing the V-50. Accordingly, the V-90 was positioned by Sony as a "semi-pro" model at the top end of the price and performance range for video cameras targeted at the consumer market. The V-90, while staying within the product configuration of the M-8 platform design and sharing important components in common with prior models, incorporated major technological improvements in virtually all key functionalities affecting the performance of the camera as perceived by the consumer.

A product intended for rapid upgrading was used to test the market

The regime of designing an initial product as an intended platform for rapid product upgrading was used effectively by Sony not just to test market demand for the initial product concept (a lightweight, compact personal video camera), but also to research (in real time) the extent of market demand for personal video cameras of increasing sophistication.

Rapid Product Proliferation

When important functional characteristics of a product can be "contained" within individual components, and when various combinations of these functional components can be accommodated within a system design, there is substantial potential for leveraging great product variety from the system design by introducing various models based on different combinations of functional components.

A study of the development of the Sony Walkman by Sanderson and Uzumeri (1990) provides evidence which suggests that Sony has used this product design regime effectively to leverage great product variety from a few system designs. Following introduction of its first Walkman model in the US market in mid-1980, Sony quickly proliferated a large number of product variations across a widening band of price points. Figure 5, from the Sanderson and Uzumeri (1990) study, shows the pattern of product introductions in the US market of Sony

Figure 5. *Sony Walkman Models Available in the US Market, by Price (1980-1990)*

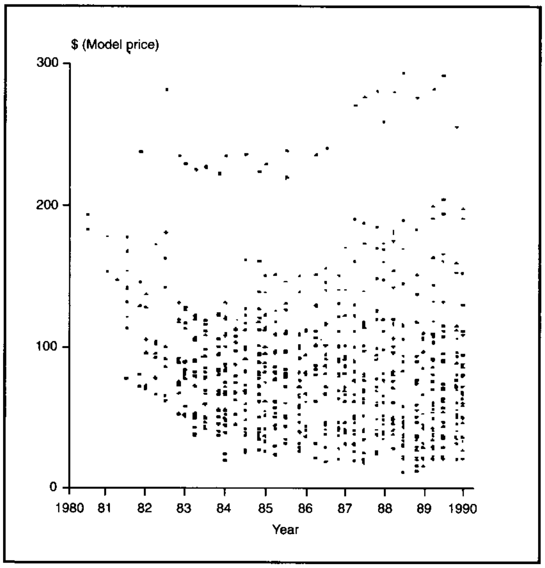
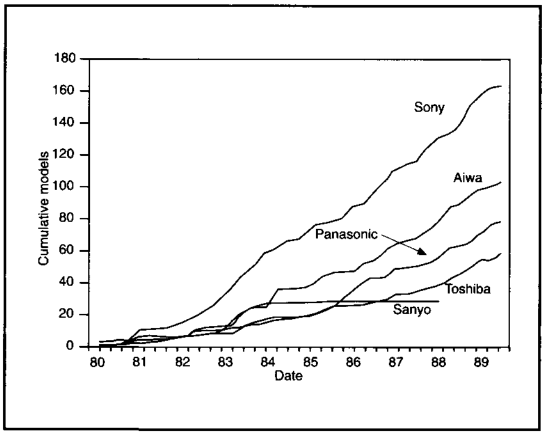


Figure 6. *Cumulative Totals of Sony Walkman Models and Walkman Clones Introduced into the US Market (1980-1990)*



Walkman models in various price positions from mid-1980 to early 1990. By 1990 a cumulative total of more than 160 Sony Walkman models had been introduced into the US market and, throughout the later 1980s, more than 20 Sony Walkman models spanning a range of price levels were available in the US market at any one time. Proliferation of models allowed Sony to test market demand for a wide range of product models at various price levels – and to saturate available product space where demand was most intense.

This proliferation of product variety is even more remarkable when one understands that the 160-plus Sony Walkman models were developed from one initial and four subsequent system designs, each of which was leveraged to create a large number of models that consisted of "rearrangements of existing, well-understood components" (Sanderson and Uzumeri, 1990, p. 7). Sony's superior capability in proliferating product variety by skilfully applying this product design regime is further illustrated in Figure 6, also from Sanderson and Uzumeri (1990). The figure shows the cumulative total of Sony Walkman model introductions in the US compared to the cumulative totals for Aiwa, Panasonic, Toshiba and Sanyo. In this context, it is interesting to note that Aiwa, the second best proliferator of Walkman-like product models, is a Sony subsidiary and often fills the strategic role of providing lower price versions of products originally developed by Sony.

Because Sony has been so much more proficient than any of its competitors at leveraging a large number of new product models from a given system design, one can reasonably speculate that Sony has significantly lower incremental costs of development and production for each new product model introduced – and therefore can engage in much more aggressive use of real-time market research to find optimal product price positions and product mixes in the marketplace. There is also some reason to believe that Sony's apparent lower marginal costs of development may, if understood by Sony's competitors, be capable of pre-empting product space, because Sony may be able to exert a credible threat that it can "squeeze" other makers' new products (which are more costly to develop and produce) into unprofitability by (profitably) positioning more new products very near to any new models which competitors might introduce. In other words, Sony appears to be using the product design regime of leveraging product variety not only to identify optimal product mix, but also to pre-empt product space and thereby to enhance the value of its leveraged product models by endowing them with some degree of monopoly power in their product space.

Remedying Some Inherent Weaknesses in Traditional Market Research

Traditional marketing research for developing new product concepts has used focus groups, followed by surveys or interviews, to lead to optimization of the product choice by using multidimensional scaling or part-growth conjoint data (see for example, Sudharshan *et al*, 1988; Green and Krieger, 1989; Wittink and Catlin, 1989). Focus groups are used to provide the firm with fundamental ideas about the attributes desired by consumers, e.g. sportiness, speed, etc. Surveys and interviews are used to determine the market positions of existing products and the existing preferences of consumers. The data gathered from the focus groups and surveys or interviews are used as inputs to various optimization models.

The attributes of optimal new products derived through this optimization process are necessarily first approximations of the "Form X Function X Price" platform for launching a new product into a given product category. The predictions of optimal products derived by this methodology are necessarily approximations for two reasons. First, customer preferences change as new products are introduced into a market (Ratneshwar *et al.,* 1986); thus, customer preferences discovered before the introduction of the new product may not correspond to customer preferences after the introduction of the new product. Second, customer preferences can change over time as customers become more familiar with the offerings in a product market; thus, consumer preferences may change between the time when consumers are polled and the time when the new product is introduced. Real-time market research, however, lets the firm overcome the inherently limited predictive methods of traditional market research by allowing it to gather data on consumer reactions in "real time", i.e. to observe consumer preferences at the time of product introduction in a setting that then includes the new product.

A further weakness of the product optimization process in traditional marketing research results from the fact that the actual size of the market for a given new product cannot be predicted with certainty using traditional methods. In fact, research shows that market size is often not well forecast with traditional methods (Mahajan and Wind, 1991). The inability to forecast market size accurately limits the ability to optimize product positions, because optimal positions in a product market will change with the size of the market. Figure 7 from Gruca *et al.* (1988) shows that the proliferation required to effectively pre-empt a product space will change with size of the product market. Comparison of the shifting of theoretically predicted optimal positions in Figure 7 with empirically observed shifting of product positions in Figure 5's display of Sony's positioning of Walkman models in the US market suggest that Sony may be using real-time market research effectively to learn the true size of the market for Walkman products and to find the optimal product positions within the market as the market evolves.

Figure 7. *Optimal Product Positions by* N=*Product Market Size*

	$N=$	$K=$
+	1	$2-\varepsilon$
+ +	2	$4-\varepsilon$
+ + +	3	$6-\varepsilon$
+ + + +	4	$8-\varepsilon$
+ + + + +	5	$10-\varepsilon$
+ + + + + +	6	$12-\varepsilon$
+ + + + + + +	7	$14-\varepsilon$

Where ε is a very small positive scalar

Source: Gruca *et al.* (1988)

Implications for Managers

Managers in a broad range of product markets must realize that rapid product development techniques and flexible manufacturing systems can be combined with new product design regimes to make real-time market research a practical, economical alternative to traditional market research methods. Firms which can successfully engage in real-time market research will gather much more accurate information about customer preferences and market size and – importantly – will be able to move quickly to exploit discovered consumer preferences for product variety or improvement. The success of firms like Sony in using real-time market research to explore, exploit, and dominate dynamic new product markets (like the Walkman) suggest that when it can be realized in a product market, real-time market research is a capability that is essential for sustained competition in that market. Firms that continue to rely on traditional predictive methods of market research will not long survive against competitors whose skills in rapid product development, flexible manufacturing, and key product design regimes make them capable of real-time market research.

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