Creating Modular Platforms for Strategic Flexibility

by Ron Sanchez

In developing products, long-term success depends on designing components that facilitate the creation of a family of current and future product options. Ron Sanchez emphasizes that this requires careful planning of shared technologies and production processes. The payoff is a modular approach that enhances the ability to integrate market-differentiating features and supports rapid innovation, stringent cost controls, and the acceleration of supply timelines.

Today, the role that designers play in helping firms define and support successful market strategies is undergoing a profound transformation. Succeeding in today's competitive product markets requires that firms have the strategic flexibility to respond more quickly to changing market demands, to differentiate more product variations for rapidly segmenting markets, and to bring new and upgraded products to market faster—all while meeting increasingly stringent product and supply chain cost targets. Growing numbers of firms today recognize that the creation of *modular platforms* is the key to enabling new kinds of strategies for meeting today's escalating market demands.

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The need for firms to create platforms capable of supporting aggressive new market strategies challenges design professionals to understand clearly what a modular platform consists of—and how creating a modular platform changes the nature of the design process and the role of designers in that process. In this article, I explain what a modular platform is and summarize some important ways in which creating a modular platform may change some of the traditional objectives of product designers. I also explain how modular platform creation calls for more extensive integration of product design and supply chain design, leading to more intensive interactions of product designers with all the aspects of the supply chain that will execute a platform-driven market strategy. Some recent examples of modular platforms created by Philips business units illustrate these issues and how they must be managed in the design process.

What is a Modular Platform?

The term *platform* has recently become a prominent part of management vocabulary all over the world. Yet like most new management terms, its precise meaning is often unclear. A perusal of current business publications soon reveals that *platform* is used in many different ways, leading to confusion about what a platform really is—and thus what a platform might possibly do strategically.

Based on my research into modular product and process architectures, as well as my work with a number of global companies in implementing platform strategies based on modular architectures, I propose that the following definition captures the essential conceptual and practical characteristics of a platform:

> A platform consists of strategically motivated and operationally coordinated modular product and process architectures designed to create specific forms of strategic flexibility that will be the drivers of a market strategy for achieving a defined set of business goals.

Let me briefly explain the key elements in this definition. First, a *platform* includes a product architecture designed to enable the configuration of a family of products or successive generations of upgraded products. A *product architecture* defines the essential technical structure of a product. It specifies (a) the decomposition of the overall functionalities of a product into specific functional components, and (b) the interface specifications that define how the functional components interact within the product as a technical system. However, a platform also includes a supporting process architecture for realizing the product variations to be configured from the product architecture. A process architecture is analogous to a product architecture and specifies (i) the decomposition of all the supply chain and production processes needed to make, distribute, and support a product into a set of functional activity components, and (ii) the specification of the interfaces between activity components that define how the activity components will interact as the production and supply chain functions as a product realization system.

To effectively support the configuring of product variations and future generations of upgraded products, the architectures in platforms must be modular. *Modular*, however, is another term that takes many meanings in current management discourse. In my research, I have tried to clarify the meaning of modularity by separating it into two types. The first form of modularity in an architecture is what I refer to as *technical modularity*, and it is created when designers specify an interface between components to allow the free substitution of some range of component variations on one or both sides of the interface. A common example of technical modularity would be the standard wheel-bolt pattern on an automobile that allows a nearly endless variety of wheel designs to be mounted to the wheel hub.

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Strategic Modularity

Creating strategically useful modular platforms requires a "higher form" of modularity, however—a form that I refer to as *strategic modularity*. Creating strategically modular architectures requires that an architecture first be strategically partitioned so that its technical decomposition follows the design principle of one-to-one mapping. Under this principle, each functionality that is perceived by targeted customers as an important source of differentiation in a product design or service activity is "contained" within a single component (or sometimes, if technically necessary, a subsystem of components). The interfaces between strategically partitioned components are then made technically modular, so that intended variations and evolutions in a product design or service activity can be readily

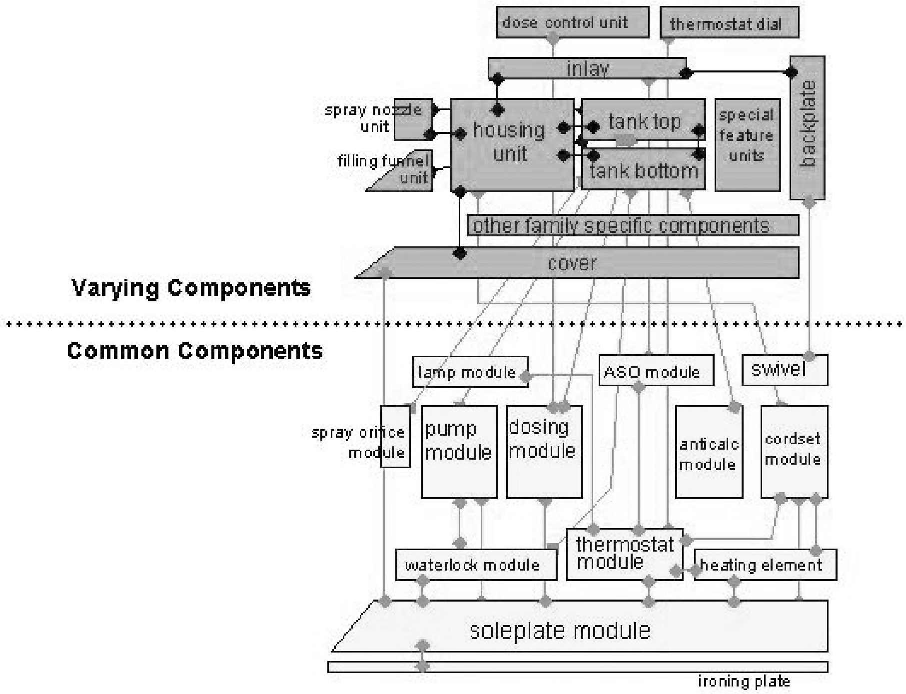

Figure 1. Strategic partitioning of modular architecture for Philips's Elance and Mistral product lines (diagram courtesy of Philips Personal Garment Care, Singapore).

configured by substituting a range of component variations into the architecture without having to make compensating design changes in other components.

Creating strategically modular product and process architectures enables designers to "design in" a number of important forms of strategic flexibility. Product and service variations intended for different market segments can be quickly configured by combining different physical or activity component variations within the modular architectures. Higher-performing products can be leveraged by substituting higher-performing components into an architecture as they become available. At the same time, disciplined re-use of standard common components to provide functions that are not sources of perceived differentiation (for example, power supplies or transformers) can lead to lower product and supply chain costs while meeting market demands for product variety and upgrading.

Figure 1 illustrates the design strategy of strategic partitioning of a product architecture. In this example, Philips's Personal Garment Care business unit in Singapore, working closely with the Philips Design Hong Kong office, created a product architecture that serves as the basis for the Elance and Mistral lines of Philips irons now sold worldwide. The architecture of the irons was strategically partitioned into two sets of components. The lower set of components in figure 1 consists of standard common components that are used in every model of the Elance and Mistral irons. These components are technically stable and are mass-produced at high quality and low cost on dedicated mass production lines. The upper set of components, however, consists of components that are used in different product variations to create a range of models with different combinations of functions, features, performance levels, and styling. These components are produced on more flexible production lines that can provide the range of component variations needed to configure the range of product variations desired for the Elance and Mistral product lines globally at any time. Because of this strategic partitioning of the product architecture, Philips's Personal Garment Care business has the strategic flexibility to configure a broad range of product models, including many regional product variations, while also achieving low production costs globally through the mass production of common component sets used in all models.

As suggested by the Philips iron example, strategically motivated modular product and process architectures are architectures in which the modular component variations that can be substituted technically into the architectures are determined by the range of component variations that are needed strategically to configure the product and service variations required by a desired market strategy. In essence, the flexibility of a modular architecture to configure a range of strategically desired product and service variations and upgrades should happen by design—as a matter of strategic intent—not by luck.

Operationally coordinated modular product and process architectures are created when each activity component in a process architecture has been designed to support the full range of product variations and upgrades to be leveraged from a product architecture, while at the same time achieving its own strategic goals for supply chain composition (for example, insourcing versus outsourcing) and performance (order lead times, order fulfillment rates, reduced inventory levels, and so on). Achieving operationally coordinated product and process architectures thus requires simultaneous co-design and co-development of the product and process architectures that make up a platform.

Finally, no designer can help a firm to create an effective platform if the business goals to be pursued through the platform are unclear. Thus, the process of creating a truly effective platform often requires that designers work closely with product line managers and corporate strategic managers to help define their business vision more precisely, to sharpen the definition of their specific business goals, and to make clear the market strategy for achieving those goals that the platform is intended to support.

A Case Study in Platform Creation: The Sunshine Project for Philips's Oral Healthcare Business Unit

A recent project to create a modular platform for the powered toothbrush business in Philips's Oral Healthcare business unit illustrates both the use of a modular platform as a basis for a market strategy and the design issues involved in creating a strategically flexible modular platform.

In May 1999, a project was initiated in the Philips Dental Care business unit (subsequently renamed as Philips Oral Healthcare) to create a new generation of powered toothbrushes. The objective of what became known within Philips as the Sunshine Project was to create a new platform of closely coordinated product and process architectures that serve as the foundation for a new business strategy in the increasingly competitive powered toothbrush market. Twenty-three months later, in April 2001, this new platform enabled Philips to bring to market a new generation of powered toothbrushes offering radically lower manufacturing costs and significantly increased product configurability, while at the same time greatly improving the speed and reliability of Dental Care's production and supply chain in responding to changing customer demands and market trends.

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In the mid 1990s, a broad range of powered toothbrush models priced from 15 to 100 euros were sold worldwide. Major producers like Philips sought to differentiate their brands of powered toothbrush largely on the basis of technical variations in brush tip designs and motions, and the specific dental care benefits claimed to result therefrom. However, the use of featuring and styling variations not directly related to basic brush-tip design and motion had also become important bases for product differentiation by the late 1990s. Philips and other producers began to add features not directly related to the brushing process itself, such as variations in plastic holder designs, battery-charge indicator lights, brushing cycle timers, and holder designs for convenient storage of brush tips. Styling changes and packaging variations became the primary means of refreshing product lines and stimulating new purchases.

More Demand, More Competition

By the late 1990s, new market dynamics had begun to reshape competition between the major players in the powered toothbrush market. As powered toothbrushes became mainstream consumer products, growing consumer demand made it possible for a major producer to achieve significant economies of scale by increasing production volumes. Producers had to undertake continual price-cutting to capture a greater share of the existing market and to develop low-priced models to build new down-market demand. Models in all price ranges became subject to price erosion of 20 to 30 percent per year. As a result, production and delivery cost levels required to compete profitably were rapidly falling in all price categories. Moreover, as prices of powered toothbrushes fell, sales of replacement brushes became the major source of profits in the powered toothbrush business. Competition between major producers like Braun and Philips become a fight to expand the "installed base" of each producer's brand of powered toothbrush to assure long-term sales of replacement brushes.

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The consolidation and globalization of retailing that swept the United States and Europe in the 1990s also had a profound impact on competition. Discount chains like Wal-Mart and Kmart in North America and Carrefour in Europe became increasingly important global retailers of powered toothbrushes and began to demand products with exclusive packaging, new shapes and colors, and other differentiating characteristics. Large retailers increasingly approached Philips Dental Care seeking speacial deals for large orders (typically between 50,000 and 200,000 units) of differentiated models or special packaging, usually with delivery requested within a few weeks. To maintain market share, build long-term sales of replacement brush tips, and thereby remain profitable, major producers like Philips had to provide a growing range of product models and packaging variations, at steadily falling unit prices, and with shortening order lead times.

Philips Dental Care had to find new ways to manage substantial, largely unpredictable variations in order levels for a growing range of product models, while at the same time containing the rapidly rising costs of supporting growing product diversity.

By 1999, it was apparent to Philips Dental Care's managers that their current product designs and supply chain capabilities were not adequate to meet these challenges. Efforts to meet growing market demands for greater diversity and faster deliveries threatened to overwhelm the business unit's production and logistics capabilities and to compromise its ability to launch new product and marketing initiatives vital to maintaining market share and building installed base. New product designs and faster production and logistics processes with much lower cost structures had to be developed, or Philips would be forced to exit the powered toothbrush market.

"We Stay Fighting"

Faced with this difficult strategic situation, Philips Dental Care's managers made a decision that they summed up succinctly in the phrase, "We stay fighting." But the decision to stay and fight meant that Dental Care would need to develop a vastly improved platform of product and process architectures that would enable significantly lower product costs, increased product variety, expanded featuring, more rapid technical upgrading of products, more packaging variations for new product models, faster supply chain response, and greater supply chain reliability.

Philips Dental Care managers began to define in more precise terms the cost targets, product diversity requirements, and supply chain performance capabilities they would have to develop to compete profitably in the powered toothbrush market over a five- to six-year planning horizon. The list of new performance targets was challenging, to say the least:

- To support goals for rapid expansion of market share, especially in the rapidly growing market for inexpensive brushes, average

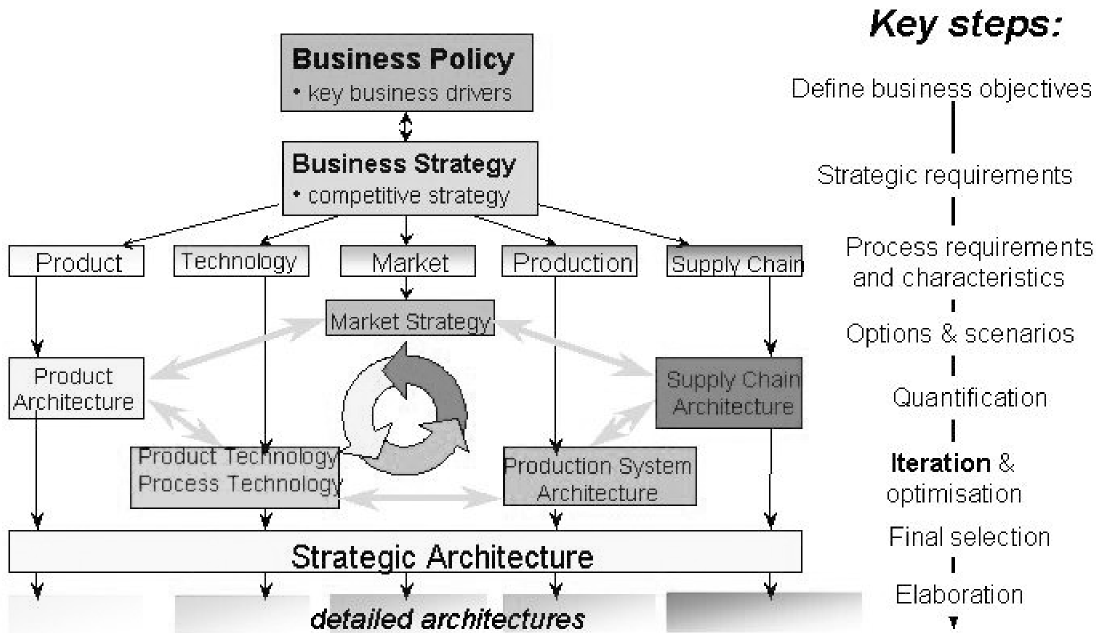

Figure 2. Philips Center for Industrial Technology's framework for analysis and integration of product and process architectures (diagram courtesy of Philips Center for Industrial Technology, Eindhoven, The Netherlands).

unit production *costs would have to be reduced by at least 45 percent.* To expand market share in the face of ongoing price erosion, the new range of powered toothbrushes would have to be sold profitably at much lower price points than previously possible and in volumes much larger than previously realized.

- Product diversity would have to expand significantly beyond the 105 models (including packaging variations) offered by Dental Care in 1999 to at least 200 different product models. Featuring would have to be expanded to offer new plastic handle shapes, new switch designs, more colors, electronic features like brushing time indicators, containers for holding brushes, and various accessory materials (for example, travel kits). Packaging variations to support sales development internationally would add further diversity. At the same time, even though product diversity would be increasing significantly in the future, carrying costs and obsolescence costs of finished goods inventories would have to be substantially reduced.
- To support development of collaborative marketing with major retailers, as well as sales initiatives launched by Philips' own national sales organizations (NSOs), Dental Care's managers realized they would have to develop nothing less than a rapid mass-customization capability. Production lead times for orders from NSOs for standard models would have to be reduced from two weeks to one week or less. Production lead times for special deals for large retailers would have to be no more than five working days. To achieve these improvements, Dental Care's inbound supply chain, its own production processes, and its logistics for deliveries to its internal and external customers would have to work together in one integrated, closely synchronized, highly reliable, and fast supply chain process. Moreover, to remain a preferred supplier to large retailers, order fulfillment rates (the percentage of customer orders actually accepted, produced, and delivered as promised) would have to increase from the 1999 level of 72 percent to at least 95 percent—and preferably to 98 percent.

After extensive discussions with product architecture and supply chain consultants from Philips's Center for Industrial Technology (CFT), Dental Care's managers concluded that only a platform incorporating an "integrated architecture" approach could achieve the chal-

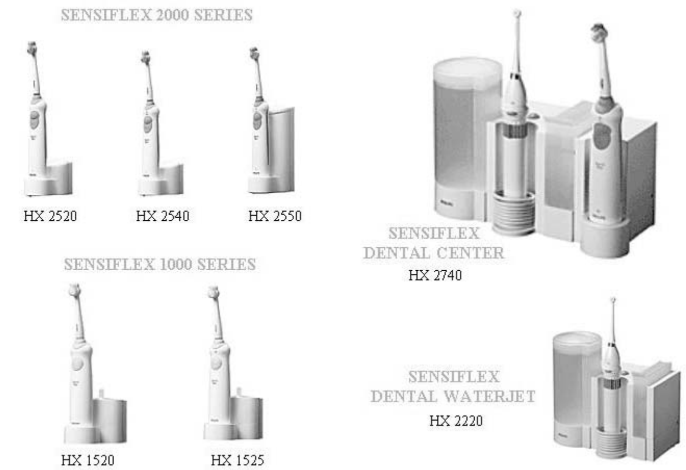

Figure 3. Basic models in Philips Dental Care's Sunshine platform (photos courtesy of Philips Oral Healthcare).

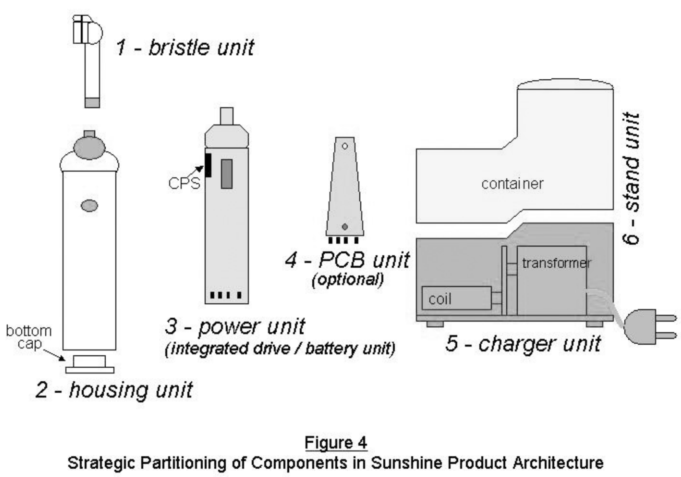

Figure 4. Strategic partitioning of components in Sunshine product architecture (diagram courtesy of Philips Center for Industrial Technology).

lenging goals facing them. The integrated architecture approach would require creating a new product architecture that was conceived to offer much lower product costs, as well as much higher levels of configurability—and that was also closely coordinated with a new process architecture designed to support significantly improved supply chain flexibilities, reliabilities, efficiencies, and speed. In May 1999, the Sunshine Project was launched to develop just such a platform.

The Sunshine Architecture

A key contribution of Philips CFT consultants to the Sunshine Project was a comprehensive architecture development model for guiding the development of new platforms. This model, shown in figure 2, defined essential relationships among key business drivers, overall competitive strategy, product diversity requirements, technology choices, market strategies, production system choices, and supply chain requirements that had to be explored and reconciled in creating a platform of well-integrated, strategically focused product and process architectures.

The Sunshine Project team soon realized that creating a strategically effective platform called for new rules to guide the development process. For example, product architecture decisions would in all respects have to be made jointly and simultaneously with process architecture decisions, and such joint architectural decisions would always have to be made with specific reference to the defined strategic objectives for the business. Costs would not be defined solely by bills of materials (BOMs) for specific product models, but would have to be defined "system-wide" with reference to all development, production, and supply chain costs that would be incurred in developing and realizing new product variations over the lifetime of the platform. Further, to achieve low component costs through economies of scale, key components would have to be standardized and used in common across all planned product models unless there was a clear strategic need and positive business case for investing in creating component variations. Decisions about standardizing components would also have to consider possibilities for using common components across product lines and product categories that have similar functional component requirements (for example, the use of common rechargeable batteries and electric motors in Philips's shavers and powered toothbrushes).

The Sunshine Project team also learned that a strategic architecture development process called for new roles. A new but especially critical role was that of architectural coordination. Someone would have to act as the "product architect" and take responsibility for identifying the desired range of component variations and establishing interface specifications that would support the desired level of product configurability. Similarly, "process architects" would have to identify and deliver the flexibilities of each activity in the production and supply chain required to assure that each stage could process the range of variations in parts, components, and products

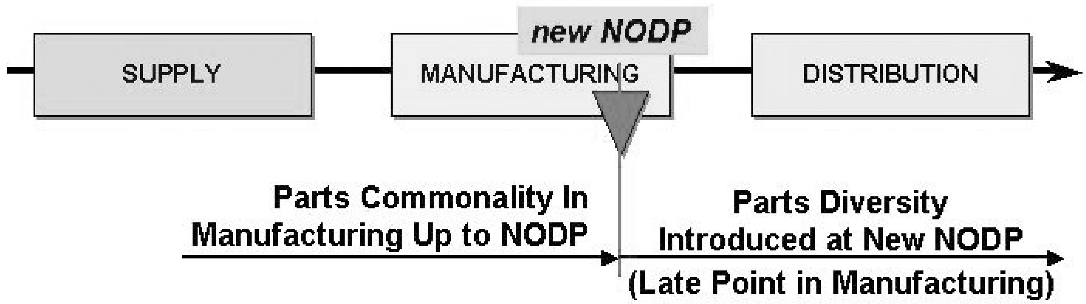

Figure 5. Last-point differentiation, National Sales Organizations (NSO) Order Decoupling Point (NODP), in Sunshine platform supply chain (diagram courtesy of Philips Center for Industrial Technology).

needed to support the business strategy. Product and process architects would have to work closely with product line and marketing managers to define the product and process architectures that jointly offered the optimal combination of cost efficiency and speed in supplying the required range of products in the mix required.

Creating the Platform

The Sunshine Project team then followed a sequence of steps in creating a new platform for the Dental Care business. Their first concern was to define the most advantageous and mutually supportive strategic partitioning of the Sunshine product and process architectures. Key steps in that process were as follows:

- Analysis of strategically desired product diversity
- Technical decomposition of the new powered toothbrush into functional components and identification of the functional component variations needed to provide the desired range of product diversity
- Strategic partitioning of the product architecture into physical components and identification of the process capabilities required to provide and support the physical component variations required to provide the desired range of product diversity
- Specification of component interfaces in the product architecture to support the desired range of product configurability

Following these steps, the Sunshine Project team defined a desired product range consisting of seven major product types to be offered in specific design variations to cover major retail price points from 15 to 79 euros over the three-year planning horizon 2001 to 2003 (see figure 3).

The Sunshine Project team then strategically partitioned the new product architecture to "contain" change and variety in a few physical components (for example, plastic handles) while defining a standard core of common mechanical and electronic components (the "power unit") that would be used in all models, as shown in figure 4. This basic but critical strategic partitioning of the powered toothbrush product architecture enabled the co-design of a production process that could achieve high levels of product variety at low production costs. The subassembly of common core components used in all models could be mass-produced at low cost in a continuous flow, while the relatively few components needed to configure product variations could be produced on demand and added to the common component subassembly in the last step in the production process (referred to within Philips Dental Care as the NODP, the NSO Order Decoupling Point, see figure 5). This strategic partitioning of the product architecture to enable "last-point differentiation" of product variations in the production process was the key to creating much greater predictability, stability, and speed in the new production process and supply chain.

SUCCESS!

By mid 2001, it was apparent that the Sunshine platform development team had largely achieved the ambitious goals for their project. Some of the main improvements achieved were:

- Largely due to the ability to mass-produce a stable set of common core components, product costs were reduced by an average of 53 percent across all product models.
- The number of significant product varia-

tions that can readily be configured from the new Sunshine product architecture was increased to more than 300. Moreover, this expanded product diversity can be configured with much shorter lead times and greatly reduced development and realization costs.

- Supply chain response time to new orders from Philips NSOs has been reduced from two weeks to one week, and lead times for filling big orders from large retailers have been reduced from four weeks to two weeks. Volume flexibility has also been greatly improved.
- Supply chain reliability has also improved significantly. The supply chain performance parameter of "orders accepted and shipped complete as ordered" has improved to more than 95 percent.
- At the same time, owing to the expanded use of standard common components and more controlled use of nonstandard differentiating components, supply chain complexity has decreased substantially.

As platform thinking and platform-driven market strategies increasingly become an integral part of state-of-the-art management practice, designers are finding that their role in creating new products is becoming increasingly intermeshed in the strategy process of firms.

The impressive results now being realized from the platform created by the Sunshine Project team have been instrumental in stimulating new platform development projects in a number of Philips business units.

How Creating Platforms Changes the Design Process

The creation of strategically flexible modular platforms adds some significant new dimensions to the traditional industrial design task. To the fundamental industrial design objectives of creating product designs that are functional, user-friendly, aesthetically pleasing, and effective in conveying the desired image of a product or service, modular platform creation adds at least three strategically critical design tasks.

First, platform designers must work closely with business strategic managers to define adequately the business goals and market strategy for a new product, especially the intended strategic positioning of a product line or service in the marketplace. Increasingly, this task is concerned not just with the designs for the first generation of a product or service, but also with planned future generations of products and services.

The key to carrying out this design task is providing business managers with better ways of analyzing and representing consumer perceptions of a product space and of the positioning of competing products within that space. The High Design methodology developed by Philips Design, for example, helps business and product line managers map the way consumers perceive a given kind of product space and identify the most strategically advantageous positioning of a new product line within that product space. Only after such analyses can the business goals and strategy for achieving those goals be defined adequately to give clear direction to a platform development process.

Second, today the commercial success of a product depends not just on its design and technical performance, but also increasingly on the performance of a firm's supply chain in getting the right product variations to the right point of distribution at the right time. Designers who participate in creating platforms must therefore interact intensively with supply chain professionals to fully grasp the operational implications of alternative product and service designs. These interactions should help designers develop insights into the most advantageous ways of strategically partitioning a product architecture to improve strategically important aspects of supply chain performance, such as supporting faster supply chain response to customer orders by partitioning product architectures to enable late-point differentiation of product variations in manufacturing processes.

Third, platform designers must help firms manage total delivered costs and not just product costs. In effect, while traditional industrial design is concerned primarily with the manufacturing cost of a product, platform designers must be concerned with all aspects of the product realization process. Costs of carrying parts inventories and work-in-process, costs of packaging and shipping, and costs of servicing and repairing products are all affected—often substantially—by product design decisions. Platform designers must therefore extensively explore these issues in defining product and service architectures that are as cost-effective as possible in meeting market demands for product variety and supply chain performance.

Making "Platform-Thinking" an Integral Part of the Design Process

The power of well-designed platforms to support aggressive, successful new market strategies is demonstrated today by firms that have understood that a platform is not just a new management buzzword based on some vague notion. Firms successfully pursuing platform-driven strategies have learned that platforms are a powerful design approach that requires clarity, definition, and discipline—as well as creativity—in conceiving strategically focused and carefully coordinated modular product and process architectures. As platform thinking and platform-driven market strategies increasingly become an integral part of state-of-the-art management practice, designers are finding that their role in creating new products is becoming increasingly intermeshed in the strategy process of firms. This new role of designers in helping firms create strategically flexible modular platforms challenges designers to broaden our design objectives and to learn new ways of working with a broader set of management professionals and strategic concerns. ■

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Note

The Philips Sunshine Project is described in greater detail in the cases *Philips Oral Healthcare (A), (B)*, and *(C)* published by IMD, Lausanne, Switzerland (case numbers IMD-3-1358, IMD-3-1359, and IMD-3-1360). Further discussion of many aspects of platform design and platform-based strategies can be found in *Modularity, Strategic Flexibility, and Knowledge Management* by Ron Sanchez (Oxford University Press, forthcoming 2004).

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