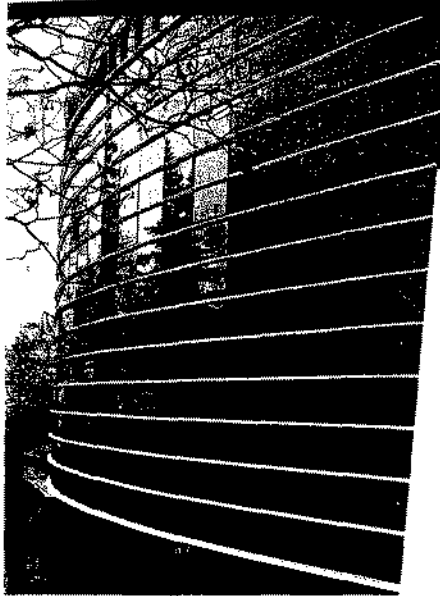


Perspectives for Managers

IMD International Institute for Management Development



Maximizing the Benefits of Modularity

Part I. Designing Strategic Flexibility into Your Products and Processes

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Modular strategies for creating products of all types – hardware, software, process products, and services – are rapidly becoming an integral part of contemporary management thinking. The benefits of “modular thinking” extend well beyond product strategies,

however, and include new approaches to creating more flexible organizations, improving management of supply chains and outsourcing, defining and managing key knowledge assets, and strategically focusing organizational learning. As companies that are currently the most advanced in modular thinking and practice are now discovering, modularity offers a powerful framework for identifying, building, and using an organization’s knowledge assets, key capabilities, and strategic flexibility.¹

Part I of this two-part “Perspectives for Managers” looks at the product strategy benefits that effective use of modular architectures can bring to an organization. Part 2 will discuss key management steps in defining and implementing modular strategies in an organization, and the use of modular product and process architectures as frameworks for knowledge management.

What is modularity?

Modularity is fundamentally a way of improving the strategic flexibility of an organization by improving the adaptability and “evolubility” of its product and process architectures. What are these architectures, and how does making them modular increase their adaptability and evolubility?

Modular product architectures

All products, whether hardware, software, “process” products, or services, are composed of functional parts. The architecture of a product refers to (i) the way a product design is broken down into its functional components and (ii) the way they are intended to interact in the product (i.e. the component “interfaces”). A modular product architecture is created when the interfaces between functional components are designed to allow the “mixing and matching” of different components to rapidly configure product variations.

Perhaps the most familiar example of a modular product architecture is the desktop computer, in which a range of microprocessors, memory cards, hard disks, monitors, keyboards and other components can be combined to configure a virtually unlimited number of computer variations. Firms in other industries are now beginning to implement similar modularity concepts to create “platforms” for fast, flexible configuration of new product variations. The product configuration flexibilities of modular product architectures have become the drivers of new product strategies in markets as diverse as automobiles, personal care products, financial services, food, software, industrial and consumer electronics, bicycles, home appliances, and professional services.²

Sony (together with its Aiwa subsidiary) used the modular architecture of its Walkman to configure more than 250 product variations in the U.S. market during a ten-year period.³ Each product variation consisted of a new configuration of components that offered consumers a new combination of functions, features, performance levels, and price points. Sony and Aiwa used this configuration flexibility to engage in “real time market

¹ Modularity concepts and their application in product strategies, organization designs, and knowledge management are discussed in depth in Professor Sanchez’ forthcoming book, “Modularity, Strategic Flexibility, and Knowledge Management”, Oxford University Press.

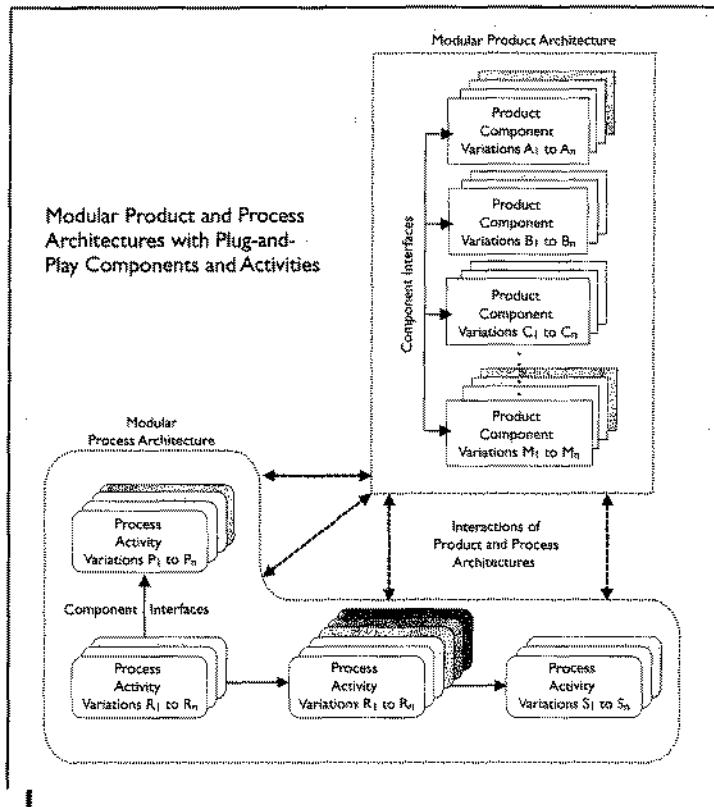
² Use of modularity in new product strategies is discussed in depth in “Modular Architectures in the Marketing Process” by Ron Sanchez (1999), Journal of Marketing (special issue on “The Future of Marketing”), 63, 92-111.

³ See Managing Product Families, Susan Sanderson and Vic Uzumeri, Richard D. Irwin publishers (1997).



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research” – using a stream of new product variations to continually test consumer preferences and fine-tune its overall mix of Walkman models.⁴

Modular process architectures

Modularity concepts can also be used to create more flexible, configurable processes. In a process architecture, an overall process is separated into its various functional activities. A modular process architecture is created when the interfaces between the activities – i.e. how each activity interacts with other activities – are defined and standardized so that different versions of each activity can be “mixed and matched” within a single stable architecture. Standardizing the way each activity interacts with others in a process architecture makes it possible to outsource more of them or to have some performed by alternative internal units, while maintaining a single consistent way of working within an organization.

Configuring manageable global supply chains, for example, virtually requires creating well-defined and standardized modular activity interfaces. Suppliers of components and services, whether global or local, may then be asked to provide components or services at various locations worldwide in a manner consistent with a single global

process design. Creating a global modular process architecture creates a foundation for working with the most capable suppliers at any location in the world that a firm has operations, while maintaining a consistent way of working globally.

Coordinating Modular Product and Process Architectures to Create Strategic Flexibility

Figure 1 illustrates modular product and process architectures that have been designed to configure product and process variations by mixing and matching available product component and process activities.

IKEA, the Swedish furniture maker and retailer, is an example of a firm that has created significant strategic flexibilities by developing strategically coordinated modular product and process architectures. IKEA creates modular designs for its Scandinavian furniture products. It carefully designs and specifies the components in its furniture products (e.g. table tops, legs, and hardware) so that they can be mixed and matched to create a range of new product variations. But IKEA has also developed a modular process architecture to coordinate the global sourcing and shipping of components for its modular furniture products.

IKEA's global modular process architecture clearly defines the way that orders will be transmitted to suppliers, the quality standards to which various types of components must be made, the way purchased components must be packed for shipment, the way shipping information must be transmitted by suppliers to IKEA, and so on. Because the way each supplier must perform its activity within IKEA's global supply chain is clearly defined, understood, and followed by all of IKEA's suppliers, IKEA can readily source components from any qualified member of its global network of more than 1800 suppliers. This strategic flexibility in sourcing components enables IKEA to flexibly configure and fine tune its supply chain to take maximum advantage of movements in currency exchange rates, fluctuations in shipping rates, suppliers' available production capacities and willingness to offer reduced prices, and so on.

Most managers today are looking for similar kinds of strategic flexibilities for their businesses:

- Manufacturing firms want to offer broader product lines or even to begin mass cus-

⁴ See “Real Time Market Research – Learning by Doing in the Development of New Products” by Ron Sanchez and Devanathan Sudharshan (1993), *Marketing Intelligence and Planning*, 11, 29-38.

tomization of products for individual customers, while taking advantage of global sourcing of materials, components and services.

- Makers of food and personal care products want to have standard global production processes that can accept a range of local variations in inputs, thus providing a range of both standard and locally adapted products.
- Firms developing new software, whether for internal use or as products, are interested in outsourcing development of software components to firms in India, Eastern Europe, or Asia, while assuring that outsourced software components will perform flawlessly within a defined architecture.

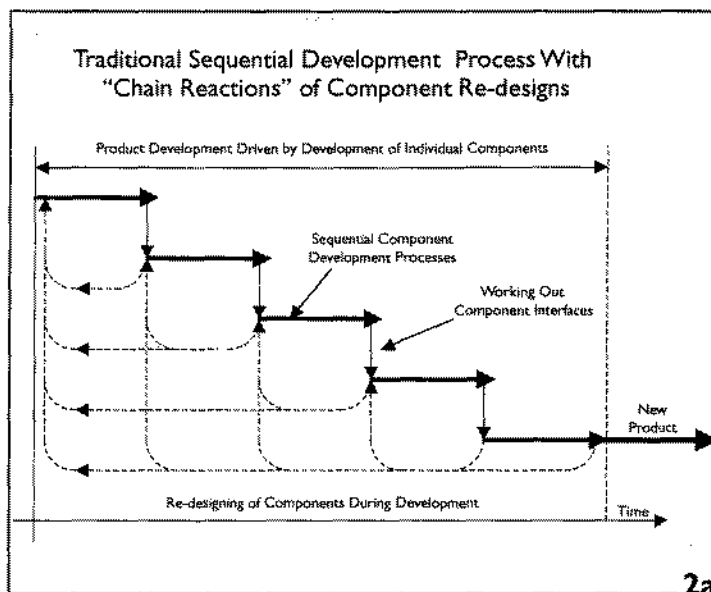
- Financial and professional service providers want to offer their clients seamless global services based on compatible activities performed by cooperating firms around the world.

Modular product and process architectures that enable the mixing and matching of product components and process activities within standard product and process designs are the key to achieving these kinds of strategic flexibilities, while at the same time reducing the complexities of operating globally.

To Get Fast – Get Modular!

Modularity is also the key to achieving another critical strategic flexibility: speed in bringing new products to market. Once a firm begins to convert its product designs to modular product architectures, it becomes possible to adopt a new way of developing products that can radically reduce time to market. GE Fanuc Automation (a world leader in industrial automation systems), Philips audio products business group and firms in other industries are now reporting an astounding 50-80% reduction in total development time and resource requirements after fully implementing the modular approach to product development.⁵

The key to radically improving speed in creating new products lies in the way the modular approach reverses the priorities that firms have traditionally followed in product development. In designing new products, most firms today first focus on developing components needed,



Frequently, it is only after significant component development work has been performed that developers begin to fully define the interface specifications required to make the components work together in a new product. Recent research has established that letting component development lead and "drive" interface specifications in this way leads to chain reactions of component re-designs throughout the development process that can consume 50% or more of total development time and resources.⁶ (See Figure 2a)

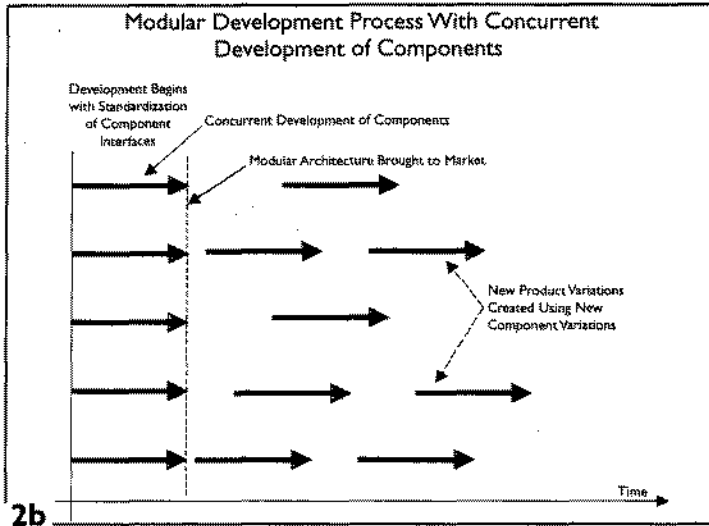
The modular approach to product development essentially eliminates time-consuming component re-designs by first working out and standardizing (i.e. freezing) the component interface specifications in a new product architecture. Development of components is then constrained to conform to the standardized component interface specifications (see Figure 2b). When component interfaces are fully specified before component development begins, and when all component designs conform to those interface specifications, chain reactions of component re-designs are eliminated.

Further, standardizing interface specifications at the beginning of development makes concurrent development of new components truly possible. As some firms have realized, attempting to design components concurrently without first standardizing component interfaces quickly leads to "concurrent chaos," not concurrent engineering. Fully specifying and standardizing the interfaces in modular product architectures

⁵ See "Competing — and Learning — in Modular Markets," Ron Sanchez and Robert P. Collins, *Long Range Planning*, December 2001

⁶ See "Modular Architectures, Knowledge Assets, and Organizational Learning: New Management Processes for Product Creation," Ron Sanchez, *International Journal of Technology Management*, 19 (6), 610-629.

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2b

is therefore the essential first step in implementing concurrent development methods that can radically reduce development time and bring new products to market faster.

Once the interfaces in a modular architecture are standardized, new product variations can be configured quickly by using new component variations that are designed to conform to the standardized interfaces and thus can be mixed and matched in the modular product architecture. But standardizing component interfaces can also be used to enable rapid technological upgrading of products. When Sony introduced its first HandyCam 8mm-format video camera, for example, the firm defined component interfaces that would accommodate a number of technological improvements in key components then under development. As higher performing components emerged from Sony's development pipeline, they could be introduced directly into the HandyCam product architecture without requiring extensive re-design of other components. This modular strategy for rapidly upgrading product performance has enabled Sony to maintain technology leadership and to dominate the market for 8mm-format video cameras.

Use Modular Architectures to Coordinate Global Development Networks and Supply Chains

Disciplined management of modular interface specifications is also the key to accessing the world of development, production and customer support capabilities outside a firm. The interface specifications for modular product and process archi-

tectures provide, in effect, the system specifications for new product components and process activities. Fully defined and standardized interface specifications enable competent developers around the world to develop new product components or process activities that are compatible with a firm's product and process architectures. Creating standardized interfaces in a firm's products and processes also makes it more attractive for suppliers to invest in developing components and activities that can be used in a firm's product and process architectures for some time to come. Defining and managing standardized interfaces in modular product and process architectures is thus a key step in coordinating global networks of developers and suppliers – and in using that network effectively to lower costs while extending market coverage.

In Part 2 of this *Perspectives for Managers*, we will consider key management issues in implementing the modular way of working.

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