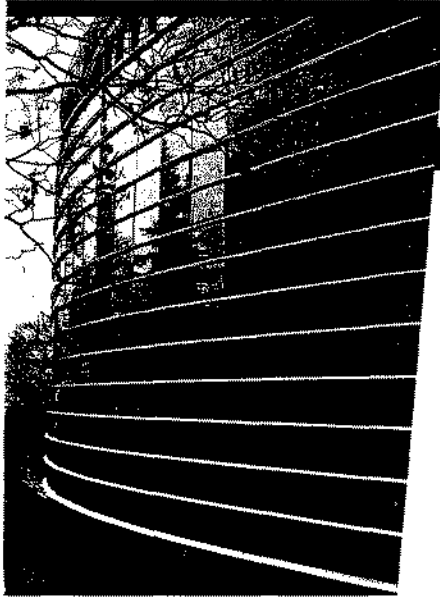


Perspectives for Managers

IMD International Institute for Management Development



Maximizing the Benefits of Modularity

Part 2. Implementing Modular Strategies in Your Organization

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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” looked at the product strategy benefits that can be brought to an organization through the effective use of modular architectures. Here in Part 2, we discuss key management steps in defining and implementing modular strategies, and the use of modular product and process architectures as frameworks for knowledge management.

New Flexibilities, New Ways of Working, New Management Intuitions

In Part I of this *Perspectives for Managers*, we surveyed several ways in which effective use of modular architectures can bring a firm important strategic flexibilities, including greater product configurability and process adaptability,

greater speed in bringing new products to market and in introducing technologically improved products, and reduced complexity in coordinating global development networks and supply chains. In Part 2, we now consider some key issues in implementing modular ways of working in an organization’s marketing processes, development activities, and knowledge management processes. These modular ways of working challenge some of the basic assumptions that conventional management thinking is based on, so we conclude our discussion with three “counter-intuitive” principles for managing in the modular way.

Use Modular Architectures to Drive New Marketing Processes

When a firm can develop modular product architectures that give it high levels of product configurability, it becomes possible to initiate new marketing processes that differ significantly from traditional practices. At the core of traditional marketing theory and practice is the assumption that developing and introducing a new product is inherently costly and uncertain, and the focus of much traditional marketing is therefore on reducing the risk inherent in bringing new products to market. As our example of the Sony Walkman in Part I of this *Perspectives for Managers* showed, however, developing modular architectures that can be used to configure potentially large numbers of new product variations makes possible new strategies and new economics for bringing a new product concept to market. The ability to introduce an evolving range of modular product models helps to increase the likelihood of a “hit” product while at the same time lowering the cost – and thus the risk – of a “miss.”²

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 Several ways in which use of modularity may fundamentally change traditional marketing processes are 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.



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Modular architectures also provide a powerful vehicle for developing more timely knowledge about evolving customer preferences. Some firms today use them to carry out real-time market research, in which new modular product variations are offered to potential customers to determine in “real time” which product variations they prefer — and what price they are prepared to pay for them. Both Sony through its Sony Shops and Nike through its NikeTown stores operate “antennae shops” in which consumers are offered a changing array of new modular product variations. Many of these modular product variations have been produced in limited batches to test consumer reactions to new combinations of components that provide new functions, features, performance levels and prices. Only when enough consumers “vote” for specific new product variations by making actual purchases are new product variations committed to full production and global or regional roll-outs.

Modular architectures also allow companies to develop deeper insights into consumer preferences for different product functions, features and performance levels at different price points. In particular, modular architectures play an essential enabling role in B2C eBusiness strategies for mass customization and product personalization. These strategies “open up” a modular product architecture to let customers configure their own product versions by choosing combinations of modular components. By tracking the component variations that customers choose first and then the tradeoffs that customers make as they receive price information, firms can take advantage of a powerful new tool for developing deeper insights into consumer preferences and price sensitivities.

New Rules and New Roles for Development Processes

Creating modular products also calls for some new approaches to developing new products and processes. These new approaches call for both new rules and new roles in development projects.³

The basic objective of modular development processes is to create specific forms of strategic flexibility — e.g. greater product configurability, greater speed to market, faster technology upgrading, etc. Creating these systemic capabil-

ities requires the *simultaneous joint design* of product and process architectures to optimize the desired forms of flexibility.

Moreover, when a modular architecture is used as a “platform” for managing product variety and change, costs cannot be analyzed only at the level of a “bill of material”, but must be evaluated within a *system-wide and forward-looking* costing framework. The system-wide cost perspective searches for opportunities to define and develop common components that can be used across product models and even across product lines. A forward-looking cost perspective methodically considers every possible opportunity for *re-using component designs* by “designing in” today the ability to rapidly introduce upgraded components in the future, as Sony did in developing its original HandyCam video cameras (see Part I of this *Perspectives for Managers*). Component development processes, however, must always be constrained to conform to the standardized component interfaces defined for a modular architecture.

Above all, to assure that development decisions are consistently made in ways that will support defined business objectives, managers must recognize that component interface specifications in a modular architecture fundamentally determine the flexibilities of the architecture as a platform for sustaining and growing a business. Interface specifications are therefore not a technical detail that can simply be left to the discretion of engineers. Managers must become involved in development processes to define the strategic flexibility goals for new product architectures, and then assure that the technical interface specifications eventually adopted for an architecture are in fact capable of delivering those desired strategic flexibilities.

Instituting these new rules for developing modular products also calls for new roles in managing development processes. Whereas conventional development processes are often largely focused on developing key new components, modular development processes give priority to first defining the standardized component interfaces in a new architecture — and then requiring component development to conform to those interface specifications. In addition, documenting and archiving interface specifications for easy reference within an organization

³ The new rules and new roles in modular development processes are discussed in greater detail in “Modular Architectures, Knowledge Assets, and Organizational Learning: New Management Processes for Product Creation,” Ron Sanchez, *International Journal of Technology Management*, 19 (6), 618-629.

becomes a vital knowledge management activity, as discussed below.

To Really Understand Your Firm's Critical Technical Knowledge Assets, Start by Clearly Defining and Documenting Your Product and Process Architectures

Among a firm's most critical assets is the technical knowledge it uses to create new products and processes. The modular way of creating new products and processes requires careful definitions of component functions and specifications of component interfaces in a firm's product and process architectures. Once these definitions and specifications are defined, however, they provide a powerful framework that can help managers and developers identify and understand more clearly four critical forms of knowledge in a firm:

- 1 Knowledge a firm uses to "translate" the functionalities desired from a product or process into a set of functional components or activities that can deliver those functionalities. For example, how does a designer define and specify components that can make a product lightweight, waterproof, impact resistant, or fault-free? How does a company design a given process to achieve speed or high levels of customer recognition? Careful architectural specification helps a firm to identify, define, and further develop the design methods it uses to create key product functionalities and process capabilities.
- 2 Knowledge of how specific kinds of components or activities must be designed to function properly and/or provide certain performance levels. When a firm's developers try to rigorously define and specify new product and process architectures, both they and the firm's managers can more clearly understand the extent to which the firm is truly "design capable" with respect to various kinds of product components and process capabilities. When product or process component functions and interfaces cannot be specified with confidence, a firm should consider partnering with other firms that have better architectural knowledge about specific components or processes.
- 3 Knowledge of how the various components in its products interact together, and how the var-

ious activities in its processes interact together. This key form of knowledge is called architectural knowledge, and it reveals the extent to which a firm's designers do, or do not, understand how its products and processes work as systems. Architectural knowledge is critical to a firm's innovation capabilities, because it determines the extent to which a company is capable of configuring new systems of components to create new product concepts and new systems of activities to create new process capabilities.

- 4 Knowledge of how each component in its product architecture will interact with each activity in its process architecture. This knowledge reflects a firm's ability to analyze how a given product and its individual components will interact with a supporting process architecture — how both components and products can be made, assembled, shipped, serviced, repaired and retired. This ability to check and coordinate product components with process activities is critical to assuring that new product and process architectures can work together to provide desired strategic flexibilities.

In traditional development processes, the lack of a clear, well-defined architectural framework for identifying and managing these four forms of a firm's technical knowledge prevents both designers and managers from developing an accurate understanding of technological strengths and weaknesses in each of the above areas of knowledge. When a company begins to follow a disciplined modular approach to creating products and processes, however, its limitations in any of the four key forms of knowledge come into sharp focus. Such knowledge limitations act, in effect, like hidden capability bottlenecks that limit its ability to define, design, and develop new products and processes. When a firm's modular architectures are used to identify its capability bottlenecks, organizational learning can then be strategically focused on overcoming the firm's limitations in each of the four critical areas of knowledge.

New Intuitions for Managing in the Age of Modularity

Modularity changes many of the basic approaches to developing new products and processes that most firms and managers are

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familiar with today. Implementing these new modular ways of working may therefore challenge managers to develop some new intuitions for managing product creation processes. These new intuitions are reflected in three new – and at first counter-intuitive – principles for managing in the age of modularity.

1 Products design organizations

Implicit in the design of every new product are specific tasks that must be performed in order to develop and realize the product. Thus, while it is obvious that organizations design products, there are many less obvious ways in which the designs determine the kinds of development and production activities it must perform or coordinate. The activities in turn determine the organization a firm should use to develop, produce, distribute, and service its products. Thus, in a quite fundamental but not always obvious way, “products design organizations”,⁴

2 Standardization increases flexibility

Standardization at one level of a system can be an essential means of increasing flexibility at a higher level. For example, standardizing the goods and services needed to take a trip by car (gasoline types, gas pump nozzle sizes, lubricant types, tire sizes, highway laws and signs, etc.) reduces the difficulty and thereby increases the flexibility of the “higher level” process of taking automobile trips. Analogously, standardizing interfaces at the component level of a product architecture can create several forms of strategic flexibility to configure new and improved product variations. Similarly, as the IKEA example in Part I of this *Perspectives for Managers* showed, standardizing the ways that activities interact in a supply chain can increase the configurability of suppliers within the supply chain to respond to changing business conditions. Thus, from this hierarchical systems perspective, “standardization increases flexibility.”

3 Discipline enhances creativity

Many people believe that creativity requires an environment with unfettered freedom to experiment. However, this view ignores the potential for duplication of effort, divergence of efforts, and simple inefficiencies that occur

when creative activities are not coordinated. The standardized component interfaces in a modular architecture provide a framework for coordinating the creative activities of developers of new components and activities to assure that the outputs of their development efforts will be compatible and work together. In effect, within the limits of clearly defined standardized interfaces of a modular architecture, there are no limits on the creativity of developers to be innovative. Discipline in defining and standardizing component interface specifications can therefore enhance the creativity of these activities undertaken within the well-defined technical environment of a modular architecture.

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⁴ See “Modularity, Flexibility, and Knowledge Management in Product and Organization Design,” Ron Sanchez and Joseph T. Mahoney (1996), *Strategic Management Journal*, 17, 63-76.