

New Product Development Chain and Managing Supplier Involvement in Product Development

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Abstract: Uncertain and dynamic environments present fundamental challenges to managers of the new product development process. While supplier involvement in the design of a product, in what can be called a product development chain, is generally regarded as being of substantial benefit. But, there has been little work done on developing methodologies that can be used to support such supplier involvement. This paper aims to address the area of product development chains by developing a framework of supplier involvement management can be formulated that consists of product development management or design management, parallel design and supplier management, and supplier integration management.

Keywords: New product development chain; Supplier involvement; Supplier management

I. Introduction

In increasingly competitive global markets, enterprises must provide products and services based on demand-oriented strategies and maintain core competitiveness by shortening time-to-market, reducing costs, improving quality and integrating the resources of other members in the supply chain. Modern organizations must increase resources spent on R&D and innovation to change their business models. Strengthening product design capability is therefore becoming a key goal of various companies.

In this competitive environment, suppliers are an increasing important resource for manufacturers. Suppliers have a large and direct impact on cost, quality, technology, speed, and responsiveness of buying company. The focus has shifted to integrating suppliers' capabilities into the firm's supply chain system and product development management. Effective integration of suppliers into the supply chain will be a key factor for some manufacturers in achieving the improvements necessary to remain competitive.

There is intuitive appeal to the idea that using the knowledge and expertise of suppliers to complement internal capabilities can help reduce concept-to-customer cycle time, costs, quality problems, and improve the overall design effort. Reports in the popular press indicate that leading companies in a variety of industries have made successful efforts in growing (Ring and Van de Ven 1994).

This research examined the extent of use of various management practices for integrating suppliers into new product development efforts in different competitive environments and focused the concept of new product development chain. By way of introduction, this article first takes a brief look at the goals of supplier involvement in product development. Subsequently, it describes the definition of new product development chain. Of these areas, we focus on the problems primarily related to the management of supplier involvement and this leads to the identification of the managerial issues of product development. At various points, our theory studies provide specific illustrations of problems and solution in managing the new product development chain.

II. New Product Development Chain

Background of the new product development chain

The design and development of a new product requires the coordination of many different skills and knowledge. Where once a single company could acquire most of these in-house, today they must look to the network of suppliers for inputs of design and process expertise (Twigg, 1998). In most companies, the R&D process follows a well-trodden, familiar path. First comes from basic research. Next, scientists with specific knowledge of the research area improve the concept until they identify an application for the basic research. Finally, they hand off the job of actually developing a commercial product and its manufacturing process to engineers down the line. But the competitive game has changed now: the advantage often goes to the companies that are most adept at choosing among the vast number of technological options and not necessarily to the companies that create them. The number of technologies from which companies can choose has grown dramatically. Advances in chemistry, information technology, electronics, and materials science, for instance, mean that the technological bases of many industries are changing rapidly and unpredictably. No single company today can research every relevant discipline the way IBM and AT&T did during the heyday of the mainframe in the 1970s and early 1980s. (Iansiti, 1997)

In a study on a range of industries characterized by high degrees of modularity, firms are increasingly struggling with

the quantity and variegated nature of external relationships, especially in what they term ‘development web’ contexts (Staudenmayer 2005). In these contexts they suggest that relationships are no longer in simple dyads but complex networks that include suppliers, customers, complementary producers, competitors, and institutions. There is a strong and long-established body of research on different forms of inter-organizational networks, which emphasizes the need to understand the embeddedness of dyadic relationships in wider networks. Indeed, an increasing amount of research on the role of networks in NPD and innovation. Combining supplier involvement in NPD studies with network theory provides an opportunity to look beyond dyadic buyer-supplier relationships as the unit of analysis and consider the impacts of the wider network of relationships.

New product development chain

In this background, we must focus our discussion on the processes of supplier involvement and collaboration in product development with respect to outsourcing and degree of supplier-buyer interdependence. Outsourcing decisions of technological systems are dependent on product architecture strategies. The extent to which a system can be decomposed with standardized interfaces determines whether component outsourcing is viable strategy. Modular product architectures, require that interfaces shared among the components of a system to be ‘loosely coupled’, hence promoting competition among suppliers, as they possess specialized expertise to innovate independently and deliver the best technological solutions to enhance performance of the system. The division of tasks through outsourcing creates a certain degree of supplier-buyer interdependence, which can vary according to the technological complexity and strategic importance of the component. The integration of supply chain has a tremendous influence in how manufacturers of complex products manage the stream of innovative products through platform and architectural design strategy by supplier’s roles in new product development and manufacturing activities of the firm.

So, the main topic of this research area now is that of how do we build a network that connects all product development parties such as suppliers, assemblers and customers, each can be located remotely, so that all product development activities can be carried out collaboratively, a network we called a “new product development chain”.

A new product development chain is an extension of design chain(Twigg,1998), which connects all product development parties such as part suppliers, assemblers, and customers with a relationship network so that all the activities associated with product development such as design, prototyping and testing can be carried out in the chain.

A suitable definition of a new product development chain can be adapted from the definition of a supply chain, as follows: “A new product development chain is a system through which organizations develop products and services to meet customer requirement. The new product

development chain encompasses the suppliers and the customers, as show in figure I, where customer requirements are passed to be suppliers and sub-suppliers, who then develop parts to be assembled and configured for the customer.”

In practice, a new product development chain is likely to be much more complex than that shown in figure I. There may be a considerable mesh of supplier to suppliers, sometimes called second tier suppliers, and so on to third, fourth and perhaps fifth tier suppliers. To compound the complexity, each participant in the product development chain may be involved in a multitude of other product development chains. Each manufacturer may, for example, be actively producing several hundred end-products, each requiring their own product development chain, probably with considerable overlap between suppliers. Meeting customer requirements under these circumstances can be very difficult. Furthermore, each new product development chain is dynamic in nature, with variations over time in the participants and in customer requirements.

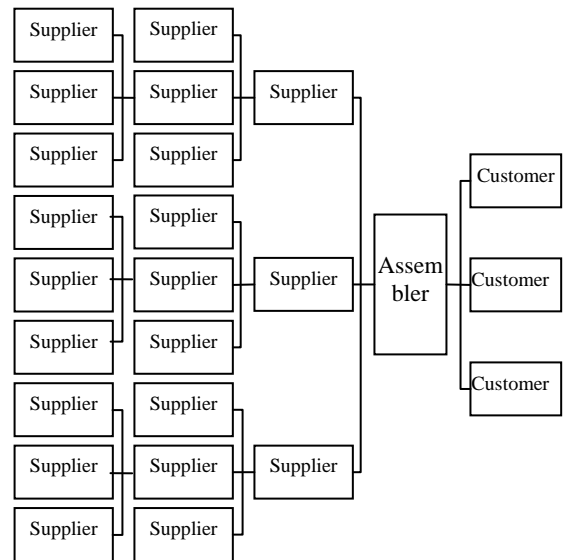


Figure 1 A Simple New Product Development Chain While much attention has recently been focused on issues in the supply chain, the area of cooperative product development with a chain of suppliers and customers remains virtually ignored. The need for a research program in the product development chain is given urgency by four developments: (1).The continual pressure to design products in order to meet diverse and rapid changing customer requirements. (2) The continual pressure to reduce product development time, to reduce costs and to improve product offerings. (3) The tendency for assemblers to outsourcing is an increasing proportion of their manufacturing. (4) The development of ways of management that allows for cooperation between assemblers, customers, and their new product development chain.

III. Managing supplier involvement in new product development chain

Outsourcing through the new product development chain allows companies to share the costs of development and to reap the benefits of higher production volumes. However, when design activities are put into practice many conflicts and issues evolve and project managers must stay abreast and be prepared to handle the situation. Potential issues that arise in the new product development chain can directly impact the cost, schedule, performance, scope and limitations of the project. Many of the issues that arise in the new product development chain are not inherent to traditional by in-house developed products. Some of these problems relate to the innovative and sensitive nature that relates to integrating new technologies and implementing new ideas. In addition, the risks of implementing tradeoffs of designing a flexible product that meets the functional, mechanical, and electrical and quality needs for both parties can be difficult for managers to gauge when considering product differentiation and maintaining consistency across product lines. So the first issue in establishing or improving the involvement of suppliers in the new product development chain is identifying the kind of managerial activities that need to be organized and carried out to support supplier involvement.

In fact, our research has shown that managing supplier involvement in the new product development chain can be defined in terms of three different management areas: (1) Product development management or design management; (2). Parallel design and supplier management; (3) Supplier integration management.

Product development management or design management

However, there are significant research issues to be addressed before such integration becomes a viable proposition, certainly for more complex products. Perhaps the central research issue is that of devising a suitable methodology to divide the design task into independent but compatible smaller design tasks that can be performed separately. This is important in that the division of design tasks provides the basis for operating a product development chain.

In broadest terms, modularity is an approach for organizing efficiently the design and production of complex products and processes (Baldwin and Clark, 1997). Typically, a design object can be decomposed into several design entities, and these design entities can be further decomposed into lower-level design entities. By repeating this process, a design object can be decomposed into many different design entities. To determine how a design object can be decomposed depends on a number of factors including the physical characteristics of the product, the functional characteristics of the product and the supplier's capabilities.

In view of the complexity of the product in the new product development chain, the need to approach the decomposing into the product from the perspective of a total view has been highlighted. System engineering provides this perspective through a structured and requirements driven approach to the characteristics of the products and their associated processes. Systems engineering structures the development process through a series of phases that address the management of customers' requirements and finally a physical analysis that maps functions to physical elements. In addition, it provides validation and verification at each phase. This structured approach begins to address the issues presented with complexity, requirements, technology and flexibility from top-down perspective. Thus systems engineering addresses the needs for decomposing the design activities in the new product development chain, supporting product development management throughout the new product development chain. Most important, it establishes the general policies and guidelines for supplier involvement in the new product development chain, and the technological areas in which to collaborate.

Parallel design and supplier management

The parallel design in the new product development chain is a design process where component suppliers, after the design task being decomposed and distributed, develop their components concurrently at geographically dispersed sites. Such parallel component design typically requires component designers to share and exchange their component design data during the design process.

Ideally, once the product development task has been decomposed and distributed, component designers should be able to develop their components independently without interacting with the other component designers. But, in fact it is decided by the product architecture. Product architecture is the arrangement of the functional elements of a product into several physical building blocks, including the mapping from functional elements to physical components, and the specification of the interfaces among interacting physical components. Product architectures can vary from integral to modular.

In integral product architectures, one-to-one mapping between functional elements and physical components of a product is non-existent, and interfaces shared between the components are coupled (Ulrich, 1995). Changes to one component cannot be made without making changes to other components. In this case, component designers need to exchange and share their component data during parallel design in order to ensure that their components can be integrated well with the other components. In addition, integral architecture designs need knowledge sharing and interactive learning as team members rely on each other's expertise in designing the architecture. So, with integral product architecture, assembler in the new product development chain must be coordinate with all the supplier

and customers, which may be able to make their products to satisfy each customer's particular needs.

In modular product architectures, one-to-one mapping between functional elements and physical components of a product is existent, and interfaces shared between the components are uncoupled. So, it can be used as flexible platforms for leveraging a large number of product variations. Modular product architectures enable assembler in the new product development chain to minimize the physical changes required to achieve a functional change. Hence, the design activities are usually made concurrently with the design of modular product architectures, and only need moderate coordination between the assembler and the suppliers or customers.

Supplier integration management

In view of the complexity of the product in the new product development chain, supplier integration management is necessary to decrease a large number of variables. Questions that arise include tier structure, degree of responsibility for design, specific responsibilities in the requirement setting process, when to involve suppliers in the product development chain, inter-company communication, intellectual property agreements, supplier membership on the project team, and alignment or organizational objectives with regard to outcomes. One of the most important activities in the new product development chain understands the suppliers' capabilities and design expertise, conducting technology coordination, and weighing the risks against the probability of success.

The possible forms of supplier integration management can be framed within the context of the generic new product development process. The new product development process is a series of interdependent and often overlapping stages during which a new product is brought from the idea stage to readiness for full-scale production or service delivery. As the product concept moves through these stages, the idea is refined and evaluated for business and technical feasibility, the design is firmed up, prototyping and testing are done, the design is finalized, and preparations for full-scale operations are finalized. During this process, cost, performance, timing, quality, and other problems often crop up, which results in tradeoffs and changes in the design. The design may be modified numerous times before it is finalized.

Supplier integration management may be conducted at any phases in the development process. In reaching a consensus on some product design decisions in any phases, assembler should develop a systematic process for defining the level and types of product technologies to be outsourced during the product development process. Whenever possible, companies are approaching the outsourcing decision from a systems perspective and are asking suppliers to increase their responsibility for subsystem integration. For example, during the testing phase, supplier integration management is a bottom-up process where assembler integrates component data from suppliers in order to test the final design results.

IV. Conclusions

While supplier involvement in the new product development chain is generally regarded as being of substantial benefit, there has been little work done on developing methodologies that can be used to support such supplier involvement. Unfortunately, new product development chains can be inordinately complex due to the large mesh of suppliers, the fact that suppliers may be involved in many different product development chains, and due to the dynamic nature of the product development chain with wide variations in customer requirements over time.

This paper aims to address the area of new product development chains by developing methodologies that can be used to manage the supplier involvement in the product development chain. It is possible to define more precisely what new product development chain and sourcing actually consists of. By developing a more explicit delineation of the new product development chain, a framework of supplier involvement management can be formulated that consists of product development management or design management, parallel design and supplier management, and supplier integration management. Such a framework may help assembler in the new product chain to implement, audit and improve the product design activities.

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Background of Authors

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