

Suppliers Involvement, Concurrent Engineering, and Product Development Flexibility in Different Industrial Clockspeed

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ABSTRACT

Increasing global competitions have instilled high degree of uncertainties into business environment. The ability of a firm to deal with uncertainty is increasingly important. This paper proposed a research model to depict the relationship among supplier involvement, concurrent engineering practice, and product development flexibility under different industry clockspeed.

INTRODUCTION

As the business evolution continues, firms are shifting from industrial systems driven by efficiency to post-industrial systems driven by quick response to customer demand for high product variety (Skinner, 1985; Doll and Tonderembse 1991). With the increasing global competition, accelerating technology change, and growing customer expectation, companies have to develop their capabilities to deal with the uncertainties that come with the time-based competitions. Fine (1998) uses the term “clockspeed” to denote the rate of business evolution. Clockspeed varies in different industries. For example, the clock ticks much faster in electronic industry than in utility industry. In the fast clockspeed environment, the sets of capabilities that earned profits and growth for companies at one point of time need to be reassessed, renewed, or sometimes even turn over to a new set of competencies in a very short order. Otherwise, companies can not maintain their competitive position in their industries or even guarantee their survival. Therefore, in the fast clockspeed environment, competitive advantages can not be sustained for a long time. The goal for a fast clockspeed firm is to find a way to move from one temporary advantage to the next one.

One way to build the capabilities of a firm to seek competitive advantages in a fast clockspeed environment is through concurrent engineering practices to establish flexibility. Concurrent engineering is the early involvement of a cross-functional team to simultaneously plan product, process, and manufacturing activities (Hartley 1992). Flexibility refers to an ability of a firm to respond to changing environment effectively (Gerwin 1993). Companies such as DaimlerChrysler use cross-functional teams to improve time, quality, and manufacturability of new product design. With the contribution of knowledge and experiences from different functional areas, product

development team can make better design decisions. Concurrent engineering practice is essential for responding to the specific customer requirement quickly, since modular product and process design is the key factor that a firm can possibly achieve customization in large volume at reasonable cost (Feitzinger and Lee, 1997). For example, Xilinx uses postponement techniques in its product and process design to avoid excess inventory and provide customization to its customer (Brown et al, 2000). Instead of performing the customization during the manufacturing process, Xilinx designs the IC so that its customers can perform the final configuration through software.

Suppliers involve in the new product development (NPD) process has become part of product development strategy for many companies. For example, Apple let Sony design the structure of PowerBook. The result was reduced size and shortened development time. DaimlerChrysler no longer provide the detailed specifications of many parts to its suppliers. In stead, it relies on suppliers to design the right parts and to find ways to lower prices. The result is DaimlerChrysler and its suppliers split the savings. Literatures show that companies have involved suppliers in their NPD processes, achieving faster project times, better product quality, and lower project costs (Clark, 1989; Clark and Fujimoto, 1991; Primo and Amundson, 2002). Therefore, supplier involvement is strategically important to build a firm's product development flexibility.

This paper intends to integrate the concept of clockspeed (Fine, 1998), resource-based view theory (Wernerfelt, 1984), and order qualifiers/winners (Hill, 2000) to explain a firm's product development flexibility through concurrent engineering (Hartley, 1992; Koufteros et al, 2001) and supplier involvement (Clark 1989; Clark and Fujimoto 1991). The research questions of this paper are as follow.

- Will the clockspeed of a company affect its level of concurrent engineering practices?
- Will the clockspeed of a company affect its level of supplier involvement in product development activities?
- Will the level of concurrent engineering practices affect the level of product development flexibility?
- Will the level of supplier involvement in product development process affect the level of product development flexibility?

In following sections, theories and concepts from different area will be described and explained. Next, research model and hypotheses will be presented. Finally, the practical and theoretical implication will be discussed.

THEORY BACKGROUND

Fine (1998) uses the short life cycle of fruit fly as an analogy for studying clockspeed of different industries and further develops the insight into supply chain dynamics and design. The term clockspeed denote the rate of evolution in business. There are two important drivers of clockspeed: (1) the rates of technological innovation and underlying technology, and (2) the extent of competitive intensity. In a very fast clockspeed environment, a firm's capabilities that earn competitive advantages need to be reassessed, renewed, and sometimes even replaced by new set of capabilities in a short order. An important lesson from Fine's study is that high clockspeed and

high uncertainties lead to hedging strategy. Companies tend to form alliance and joint venture to reduce the risk and control industry standard in a high clockspeed environment.

Resource-based theory (Wernerfelt 1984) views firms as a set of resources that include tangible assets such as plants and equipments as well as intangible assets such as patent, knowledge, production experience, customer loyalty and culture. Firms use these resources to build idiosyncratic practices that are not easy to duplicate by their competitors to establish competitive advantages.

Order qualifiers and order winners are the criteria that link marketing strategy and manufacturing strategy (Hill, 2000). Order qualifiers are the criteria a company has to meet for a customer even considers it as a possible supplier. Order winners are the criteria that win customers' order. To provide order qualifiers, companies only need to be as good as competitors. To provide order winners, companies need to be better than competitors. Since strategy is market and time specific, not all order qualifiers and order winners are the same for all companies. Companies need to assess their business environment and carefully determine their order qualifiers and winners to formulate their operations strategy. Order qualifiers and order winners will guide the operations strategy regarding the product plans and process choices.

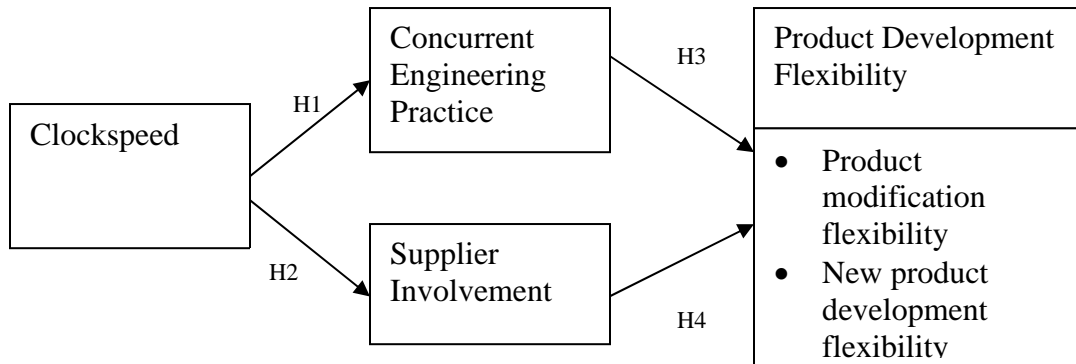
The argument of this paper is that in fast clockspeed environment, companies have to assemble internal resources such as experience, knowledge, technology from different functional areas to make organizational decisions faster to respond to order qualifiers and order winners. For a fast clockspeed company, being able to meet the demand uncertainty and to provide customization in a reasonable speed and cost can be the order winner. As firms evaluate the existing resources and learn that existing resources are not adequate to sustain the competitive advantages, firms have to search for resources beyond organizational boundaries. The external resources such as knowledge and capacity of external suppliers can help firm build the flexibility to reduce risks and to renew competitive capabilities. The clockspeed concept provides the explanation that competitive advantages are not sustainable unless the competitive capabilities are constantly reassessed and renewed. As the result of the reassessment, the order qualifiers and winners may change over time. Order winners and qualifiers provide the concept that link the business strategy with operations strategy and further guide the direction of product development. Resource-based view provides the basis that firms uses their resource to build the practices that are difficult to imitate by others to sustain competitive advantages.

Schroeder et al. (2002) suggest there are three types of resources and capabilities that are not easy to copy including: proprietary process and equipment, internal leaning, and external learning. Product development is an organizational practice that assembles internal and external resources to build proprietary process and facilitate internal and external learning through product development experience. Therefore, the product development practices are not easy to duplicate by others and can provide the flexibility for firms to compete in a dynamic market.

RESEARCH MODEL AND HYPOTHESES DEVELOPMENT

A research model based on the theories/concepts in the previous section is presented to depict the relationships among clockspeed, concurrent engineering practices, supplier involvement, and product development flexibility.

Figure 1. Research Model of the Effects of Concurrent Engineering and Supplier Involvement



Clockspeed represents the rate of evolution in business. There are two forces that drive clockspeed: the rate of innovative technology change and the intensity of competition in the industry (Fine, 1998). Therefore, a firm's clockspeed can be conceptualized as the rate of product and process technology change and the duration of product life cycle. When a firm's clock ticks faster, it has to organize internal and external resources to make organizational decisions faster to respond to quick changing environment such as customers' changing demand in term of variety and volume.

Concurrent engineering is one of the organizational designs to cope with uncertainty (Koufteros et al., 2001). Concurrent engineering practice consists of cross-functional team, concurrent work flow, and early involvement of constituents. The emphasis of concurrent engineering practices is to bring the expertise and experience from different functional areas so that the better product design can be made. In addition, different tasks can be carried out by different functional area simultaneously, therefore it shortens the product development cycle time. With the early involvements of constituents, the design, cost, sourcing, and manufacturability issues can be addressed early to avoid the delay of product development and product defects in the future.

Since the composition of concurrent engineering practice is cross-functional team that is easy to be reconfigured to meet the different needs for a dynamic environment, therefore, it can be hypothesized that a firm with fast clockspeed will be more likely to use concurrent engineering practices to cope with uncertainties. Mendelson and Pillai (1999) study the relationship between

clockspeed and organizational decision in electronic industry and the results support that higher colockspeed are associated with faster execution of product development and shorter product development time. Empirical research also supports the firms operate in uncertain or equivocal environments will adopt higher levels of integrated product development practices (Koufteros et al. 2002).

H1: A firm's clockspeed is positively associated with its level of concurrent engineering practices.

Supplier involvement in product development process has become part of integrated product development trend (Gerwin and Barrowman, 2002). Supplier involvement in NPD may range from the consultation from suppliers to having suppliers fully responsible for the design of the components they will supply. Thus, supplier involvement refers the extent of suppliers' direct involvement in product development activities. The extent of supplier involvement can be determined by the frequency of design-related communication between suppliers and NPD team (Swink, 1999) and the extent to which suppliers influence decision-making of product design (Wasti and Liker, 1999).

Fine's study (1998) shows that in the higher clockspeed environment, companies tend to form alliance to reduce risks. One form of strategic alliance is to involve supplier in product development process. Case studies (Kenneth et al., 2003) suggest that as technology uncertainties present, suppliers are more willing to share information with NPD team. Therefore, it can be hypothesized that a firm with higher clockspeed will have higher level of supplier involvement in product development activities.

H2: A firm's clockspeed is positively associated with the level of supplier involvement in product development activities.

Product development flexibility can be defined as ability to introduce new products or to modify existing product quickly and effectively (Suarez, 1995; Gerwin 1993; Zhang et al., 2002). Flexibility has three attributes: range, mobility, and uniformity (Sethi and Sethi, 1990; Upton 1995). In the scope of product development flexibility, *range flexibility* refers to the number and variety of products modified or new products introduced; *mobility flexibility* refers to cycle time of product modification or new product development; and *uniformity flexibility* refers to cost and quality of product modification or new product. Concurrent engineering is an organizational design that facilitates modularity design, enhanced manufacturability, shorter product development cycle, and better product quality which are essential capabilities for product development flexibility.

The foundation of product development flexibility is based on the organizational design that can configure and reconfigure resources rapidly to respond to environment change. Concurrent engineering is the practice that assembles resources such as the experience and knowledge from different functional areas and these resources are easy to be reconfigured to respond to product design or process design change. Therefore, it can be argued that a firm that has higher level of concurrent engineering practices will have higher product development flexibility.

H3: the level of concurrent engineering practices of a firm is positively related with its level of product development flexibility.

Suppliers' knowledge and capacity can be viewed as the extended resources of a firm. The benefits of supplier involving in NPD including: (1) enhancing information and expertise regarding new technology or ideas, (2) providing resources to achieve faster project time, (3) being able to detect problems early so that reworks can be avoided and product quality can be improved, (4) providing the possible route for outsourcing so that project complexity can be reduced, and (5) improving communication to avoid project delay (McIvor and Humphreys, 2004). The above benefits can enhance product development flexibility in term of range, mobility, and uniformity. Researches support that companies involve suppliers in their NPD process achieving faster project times (Clark 1989, Clark and Fujimoto 1991), better product quality, and lower project costs. Swink (1999) found a positive effect of supplier influence on new product manufacturability. These outcomes are essential for the product development flexibility to achieve.

H4: A firm with higher level of supplier involvement in product development process will have higher level of product development flexibility.

DISCUSSION

The theoretical implication of this study is that resource-based theory (Wernerfelt, 1984) can be integrated with the concept of clockspeed (Fine, 1988) to explain that firms have to evaluate their resources often to renew the competitive advantage. Clock is ticking faster for some industries such as computer and electronics industries than other industries such as food and oil industries. As the process and information technology change accelerating, it is inevitable that clockspeed for every industry is becoming faster. Internet technology has created new channels for buyers to reach suppliers and for suppliers to reach buyers at anytime and from any places. As the mass market is vanishing, it is important to allocate firm's resources effectively to respond to the dynamic business environment.

The practical implication of this study is that concurrent engineering and supplier involvement are the organizational practices that build a firm's flexibility. With increasing competition intensity, companies have to incorporate the product development into business strategy and operation strategy to build flexibility for the demand uncertainty. Modularity design is the trend of building the flexibility for product variety at different volume. However, the efforts of modularity design have come from different functional areas and sometimes across organizational boundaries. Therefore, concurrent engineering practices and supplier involvement in NPD should be built into the organizational design to facilitate the communication, coordination, and knowledge sharing. These practices will create the dynamic capabilities for a firm to build competitive advantages under uncertain business environment.

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