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A dynamic model of supplier–customer product development collaboration strategies

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ABSTRACT

This study examines transitions between different types of product development collaboration in supplier–customer settings, the events that trigger such transitions, and the emerging requirements for suppliers. The current study contributes to the literature regarding supplier and customer involvement by combining previously discovered types of collaboration into a dynamic model that describes these different types as alternative modes of collaboration that can be implemented in a relationship. Transitions between different types of collaboration are identified in a longitudinal case study. Three of the four transitions identified took place in the same dyad, which demonstrates that it is possible to change the type of collaboration without losing the advantages of a long-term relationship with a customer. The most radical change in collaboration—the change from supplier involvement to customer involvement—involved temporarily discontinuing the original relationship, which indicates that this transition incorporates the highest risk of relationship termination. By offering a dynamic model for product development collaboration, this study is the first to analyze changes between different types of customer–supplier product development collaboration from a supplier's perspective. The dynamic view is important for companies seeking to take advantage of their long-term relationships instead of starting new ones when new requirements for product development collaboration emerge.

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1. Introduction

Companies across industries are seeking relational advantages through product development collaboration. To develop complex products, companies need to safeguard a level of collaboration within supplier networks because suppliers retain specific knowledge of the subassemblies that they offer. Furthermore, suppliers serve as an access point for the technologies and capabilities needed for development (Johnsen, Phillips, Caldwell, & Lewis, 2006). In the last three decades, scholars have extensively examined product development collaboration among industrial companies (Dyer & Singh, 1998; Johnsen, 2009; Takeuchi & Nonaka, 1986). The collaboration between suppliers and customers regarding product development can be divided into two main streams in the literature: supplier involvement and customer involvement. The supplier involvement literature focuses on the role of suppliers in the customer firm's product development (Johnsen, 2009; Takeuchi & Nonaka, 1986) whereas the customer involvement literature investigates customer participation in a supplier's product development (Kaulio, 1998).

However, these literature streams fall short of discussing the potential to adjust or change the type of product development collaboration

to correspond to changing needs. The form of collaboration is typically studied as a static phenomenon, with costs and benefits associated with various types of collaboration (e.g., Gruner & Homburg, 2000; Ragatz, Handfield, & Petersen, 2002). The rationale for the static approach is that the customer simply switches to another supplier when what it needs the supplier to contribute changes during product development (thereby initiating a new (but static) collaboration). This study considers dynamic alterations in the form of collaboration in a given customer–supplier dyad instead. The potential for the important development of the supplier's role in collaborations and the changes to the types of collaboration make it possible for suppliers to leverage product development collaboration and to exploit the benefits of a long-term relationship between suppliers and customers (Holmlund, 2004).

The current study aims to advance both supplier and customer involvement research, and in so doing to assist companies to identify the most valuable collaboration type among their current product development collaboration relationships. To attain those goals, this study analyzes the possibility of switching between different types of product development collaboration; the reasons that might prompt such changes; and the adjustments suppliers would have to make to switch from one collaboration type to another. To make this examination possible in a long-term relationship, and in contrast to the majority of prior research on customer and supplier involvement, this study relies on a longitudinal case study. As the transitions revealed in this study were completed while the original dyad continued to function, this study proves both that the type of product development collaboration is not

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an unchangeable characteristic of a relationship, and is not something that can be developed only at the cost of supplier substitution. Analyses of such changes result in a model that combines different types of product development collaborations and illustrates the directions in which companies can develop their dyadic collaborations.

The article is organized as follows. After the introduction an overview of the literature on supplier–customer collaboration is provided and a conceptual framework for collaboration developed. The third section outlines the methodology and data used. The fourth section presents the findings derived from the study of transitions, and finally, the paper concludes with a discussion of the results and their implications for the management of supplier–customer development collaboration and theory.

2. Supplier–customer collaboration in product development

Håkansson's (1987) view of long-term relationships between buyers and solution providers as a source of innovation serves as the basis for both supplier involvement and customer involvement in product development. The logical reason for collaboration on product development is provided by the complementary knowledge (Makri, Hitt, & Lane, 2010) and complementary resources that collaborating companies bring to the process (Barney, 1991; Dyer & Singh, 1998; Miotti & Sachwald, 2003). By combining their diverse capabilities, companies can generate new technologies and create products that would not have been possible using only homogenous knowledge and resources. Complementarity in capabilities also leads firms to prioritize knowledge sharing over cost issues (Sakakibara, 1997), which is in the interest of suppliers. To capitalize on complementary knowledge, firms require an extensive information exchange between key customers and suppliers. This information exchange has been seen as a fundamental factor necessary for successful product development (Katz & Tushman, 1981; Von Hippel, 1986, 1988) and the ultimate need for such an exchange arises from the asymmetric nature of business relationships in which the “need” information is on the customer side and the “solution” information is retained by the supplier (Thomke & Von Hippel, 2002). Direct communication with customers offers suppliers rich knowledge by facilitating the transfer of complex information (Salomo, Steinhoff, & Trommsdorff, 2003). Broad and deep information that is gained through intensive communication within the customer relationship is important because it increases the quality of the development process and facilitates joint learning (Brown & Eisenhardt, 1995; Huikkola, Ylimäki, & Kohtamäki, 2013).

To satisfy the need for extensive information exchange and to use complementary resources efficiently, companies therefore adopt supplier and customer involvement strategies in their product development relationships. Supplier involvement, which is defined as “the tasks suppliers carry out on behalf of the customer, and the responsibilities they assume for the development of a part, process or service” (Van Echtelt, Wynstra, van Weele, & Duysters, 2008, p. 182), has been proven to result in lower development and product costs, fewer engineering changes, higher quality with fewer defects, greater reliability, shorter time to market, highly standardized components, detailed process data and innovativeness (Bonaccorsi & Lipparini, 1994; Feng, Sun, & Zhang, 2010; Monczka, Handfield, & Scannell, 2000; Ragatz et al., 2002; Sun, Yau, & Suen, 2010). Following Kaulio's (1998) definition, customer involvement is seen as the “interaction between customers and the design process”. It is suggested that customer involvement leads to better innovation performance by helping companies recognize market and technology opportunities, generate new ideas and prevent them from developing poor designs (Lin, Chen, & Chiu, 2010; Tsai, 2009; Von Hippel, 1988). It has also been proven to enhance product quality, delivery reliability, process flexibility and customer service (Feng et al., 2010; Sun et al., 2010).

In contrast to studies that have identified benefits from both supplier and customer involvement, some studies have argued that collaboration

can lengthen the development cycle (Zirger & Hartley, 1994), increase costs (Ittner & Larcker, 1997) or lead to limited opportunities (Callahan & Lasry, 2004) and to ideas that are overly exploitative (Frishammar & Horte, 2005). To avoid such potential drawbacks, firms should align product development collaboration with contextual factors that affect the results from the supplier and customer collaboration, such as product modularity, product innovativeness, internal coordination, product complexity, information processing capability and motivation (Lau, 2011; Zirger & Hartley, 1994).

2.1. Types of customer and supplier collaboration

Highlighting the varying nature of supplier involvement relationships, Petersen, Handfield, and Ragatz (2005) applied a typology that distinguished supplier involvement collaboration into three different types. The type where the supplier's role is the most comprehensive is referred to as *black-box* development. In this type, the supplier takes primary responsibility for providing a solution to the customer according to a list of requirements that the customer has established. In *black-box* development, the supplier is responsible for developing the component or subassembly. A second type of supplier involvement is *gray-box* development where cooperation plays the most important role. Design is undertaken together, and collaborative companies often share an office to facilitate information exchange during product development. *Gray-box* development allows firms to effectively integrate a supplier's processes in the design (Koufteros, Cheng, & Lai, 2007). The third form of supplier involvement is the *white-box* development where design is customer driven and the supplier's role is limited to commenting on the customer's design. In a *white-box* development, the supplier's contribution typically relates to input on whether the new component can be manufactured.

In the field of customer involvement, a similar type of classification system has been provided by Kaulio (1998), who divided customer involvement in product development into three categories. In the first type, *design for customer*, development is supplier driven; the supplier's engineers carry out the design work and are the main actors. Data related to customer needs are gathered by using market research methods and are then turned into performance measures. The design process is guided by these data, but the customer's role is limited to passing on customer-specific data via interviews or survey replies. The second type in Kaulio's (1998) typology, *design with customer*, features more collaboration, as the product concept and solutions are developed through collaboration between customer and supplier. The design with customer type, is marked by on-going dialog between customer and supplier during the product development process. Collaborative companies discuss and compare various potential concepts and prototypes. The third type, *design by customer*, is a customer-driven product development type where the customer actively designs the product. The distinction between the work of the supplier's designer and the customer becomes blurred, with the customer taking a significant role in the process of developing and selecting a design solution. A supplier's role is to help the customer find realizable solutions to their problems. Furthermore, Koomsap (2011) states: “[in DBC, customers] are guided to define the fittest alternative that meets the cost, schedule and the product requirements through the capabilities of a company”.

The two classification systems mentioned above share many characteristics. Both focus on product development collaboration between suppliers and customers. Both divide collaboration types into three categories, and in both classification systems the defining factor is the extent of the contribution that the collaborators set up the product development. As Fig. 1 demonstrates, the supplier-involvement type *gray-box* integration is comparable to that of *design with customer* in the customer involvement typology. *Black-box* and *white-box* integrations are similar to *design for customer* and *design by customer*, respectively.

Because many of the characteristics of supplier involvement and customer involvement are both similar and opposite to one another

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