



## An investigation of the black-box supplier integration in new product development



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### ABSTRACT

This research examines black-box supplier integration in new product development (NPD). A model and several hypotheses are proposed to study the relationship between product task characteristics (importance and complexity), supplier integration, and product performance. Data from 136 U.S. high-tech firms were used to test the hypotheses. Results suggest that assessing the importance and complexity of NPD tasks is critical to the implementation of supplier integration innovation strategy. Firms are likely to perform NPD tasks that are related to firms' core competencies in-house. They tend to externalize complex tasks to suppliers in order to utilize suppliers' resources and to increase NPD speed. The black-box supplier integration influences the speed to market. However, it is more effective on speed to market when technology uncertainty is low than when technology uncertainty is high.

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### 1. Introduction

Supplier integration in NPD refers to the collaborative involvement of suppliers in a firm's NPD process in order to fulfill customer requirements (Perols, Zimmermann, & Kortmann, 2013). Different supplier integration mechanisms have been proposed including supplier partnerships, supplier development (Koufteros, Vickery, & Droke, 2012), black-box supplier integration, and gray-box supplier integration (Handfield, Ragatz, Petersen, & Monczka, 1999). Supplier integration in NPD has been viewed as a means for sharing risks and acquiring supplier expertise and technical capabilities that can be transformed to enhance the manufacturing firm's product competitive advantage (Koufteros et al., 2012). Supplier integration in NPD involves suppliers to execute certain NPD tasks such as the development of components or subassemblies.

Despite the significant progress in supplier integration research, little empirical research has been reported in the NPD literature that addresses the management of various tasks in supplier integration in NPD. Koufteros et al. (2012) have conducted extensive research on the integration of supplier capabilities, supplier partnership and development, and buyer firm's competitive performance. They call for "more precisely defined supplier integration mechanisms" "in terms of activity and scope" (pp. 110) as a direction for future research. Previous research on supplier integration has investigated the role of

suppliers from partial involvement to full responsibility in the development of the entire component in NPD, known as black-box integration (Handfield et al., 1999). With black-box integration, the supplier is given almost complete responsibility for certain NPD tasks based on the firm's requirements (Koufteros, Cheng, & Lai, 2007). Although some studies have addressed the task characteristics in product development, few have examined how to manage different NPD tasks in black-box supplier integration (Mikkola & Skjoett-Larsen, 2003). A better understanding of NPD task characteristics and their relationships with black-box supplier integration could improve knowledge of inter-firm cooperation in NPD.

This study addresses two important issues: (1) management of different tasks in the black-box supplier integration in NPD, and (2) how the black-box supplier integration influences manufacturing firms' NPD performance. A model is developed to study relationships between NPD task characteristics (strategic importance and complexity), the black-box supplier integration, and NPD performance (product innovativeness and speed to market). Research hypotheses are developed based on resource-based theory tenets, and the literature on supplier integration and product innovation management. The resource-based theory argues for protection of the firm's core competencies, and pertains to the utilization of external resources and capabilities to improve the efficiency of the NPD process if resources are not available internally (Verona, 1999). The present research also addresses two important managerial concerns in NPD: (1) which tasks should be retained by the firm itself so that the firm's core competencies are protected and strengthened, and NPD is performed more effectively and efficiently? (2) which tasks should be delegated to suppliers so that suppliers' expertise and resources are incorporated into NPD process, and the NPD

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performance is enhanced? As many product managers turn their attention from primarily internal designs to the combination of internal and external designs, the present research should offer managerial guidelines for improving NPD effectiveness and using internal and external resources and capabilities to their greatest extent.

## 2. The model and hypotheses

**Fig. 1** presents the model for studying black-box supplier integration in a firm's NPD. The antecedents of black-box supplier integration are the strategic importance and complexity of NPD tasks. These two dimensions are identified in previous studies such as [Tatikonda and Rosenthal \(2000\)](#) and [Wasti and Liker \(1997\)](#), which capture the overall execution challenge these tasks pose to the firm. Strategic importance relates NPD tasks to the firm's core competencies. Complexity affects the efficiency of the NPD process. The lesser the importance and the greater the complexity of NPD tasks, the more likely the firm is to use black-box integration. Black-box integration positively influences product innovativeness and speed to market. The moderating effects of technology uncertainty on the relationships between supplier integration and product innovativeness and speed to market are also investigated.

### 2.1. Black-box supplier integration

Much research relating to supplier integration has been conducted according to the responsibility of suppliers in NPD ([Lau, Tang, & Yam, 2010](#)). In the study by [Handfield et al. \(1999\)](#), supplier involvement is described as the degree of responsibility in NPD ranging from "None" (no supplier involvement) to "Black-Box" (design is totally supplier-driven), based on the firm's performance specifications (see also [Koufteros et al., 2007](#); [Swink, Narasimhan, & Wang, 2007](#); [Wasti & Liker, 1997](#)). Similarly, [Clark's \(1989\)](#) early work illustrates black-box supplier involvement in NPD in which parts are created by suppliers based on the firm's requirements.

In this study, the black-box integration concept from [Handfield et al. \(1999\)](#) and [Petersen, Handfield, and Ragatz \(2005\)](#) is adopted. In black-box integration, the supplier assumes almost complete responsibility for designing the parts, components, or subassemblies according to the firm's product specifications ([Clark & Fujimoto, 1991](#)). This conceptualization is consistent with previous research on the manufacturer–supplier co-development in NPD in which the supplier independently undertakes certain design tasks ([Clark, 1989](#)). The manufacturer and supplier are required to work closely with each other to ensure NPD success.

### 2.2. Resource-based theory

Resource-based theory views firms as bundles of resources which are combined to create firm competitive advantages ([Wernerfelt, 1984](#)). According to resource-based theory, firms need to continuously develop and accumulate valuable resources that are scarce, inimitable, and durable in order to succeed ([Eisenhardt & Schoonhoven, 1996](#);

[Verona, 1999](#)). The supplier's valuable resources are not perfectly tradable since they are embedded in the supplier's routines and mingled with the supplier's other resources ([Das & Teng, 2000](#)). Therefore, supplier integration is employed to access and combine supplier resources in NPD. [Collis and Montgomery \(2008\)](#) recognize that many of the resources and capabilities essential to competitive advantage lie outside the firm's boundaries. [Grant \(1991\)](#) further argues that outside resources should be considered when needed resources and capabilities are not available internally.

Consistent with the resource-based theory, black-box supplier integration is the combination of international resources of the manufacturing firm with the resources and capabilities of suppliers in NPD in order to achieve superior product competitive advantage ([Koufteros et al., 2012](#)). Black-box supplier integration is regarded as a means to capture new expertise from suppliers in NPD that firms find difficult to develop internally ([Eisenhardt & Schoonhoven, 1996](#); [Swink et al., 2007](#)). Through black-box supplier integration, the firm can gain "otherwise unavailable competitive advantage and value for the firm" ([Das & Teng, 2000](#), p. 36). [Eisenhardt and Schoonhoven \(1996\)](#) note that there are limitations in relying solely on resources internal to the firm for generating NPD because it is unlikely that the firm possesses all the required knowledge. In order to succeed with NPD, resources currently outside the firm must be acquired and integrated with those developed by the firm itself ([Collis & Montgomery, 2008](#)). Black-box supplier integration strategy allows the firm to externalize certain tasks to suppliers, thereby optimizing cost, quality, and speed ([Koufteros et al., 2007](#)). Further, black-box supplier integration enables the firm to redeploy its superior resources in NPD. Firms can thus focus their limited resources on important tasks, which contribute to superior NPD performance ([Das & Teng, 2000](#)). NPD literature also suggests that giving some tasks to other firms is a necessity for the full implementation of new product strategies ([Quinn & Hilmer, 1994](#)).

### 2.3. Importance of NPD tasks and black-box supplier integration

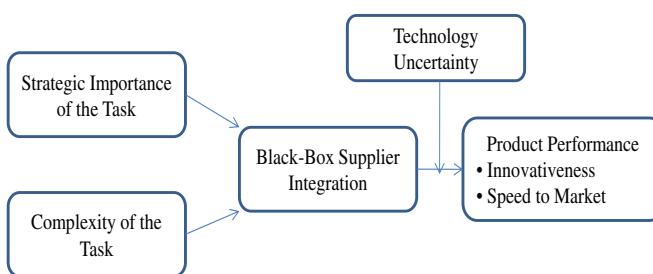
The importance of a NPD task is defined as the degree to which the task is related to the firm's core competencies and customer value creation ([Amaral & Parker, 2008](#)). The resource-based theory emphasizes the critical role of the firm's core competencies ([Wernerfelt, 1984](#)). Researchers specifically warn firms of the danger of losing core competencies through inter-firm cooperation in NPD ([Kurokawa, 1997](#); [Robertson & Gatignon, 1998](#); [Verona, 1999](#); [Veugelers & Cassiman, 1999](#)). The simplest way to protect core competencies is not to give away much of the firm's unique competence at the outset. In other words, the firm does not share all of its important technology, but simply performs these functions on its own ([Amaral & Parker, 2008](#)). Honda, for example, keeps the design and manufacturing of small engines in-house because they are related to the company's core competencies.

In NPD, one risk that the firm takes is that other firms may imitate the technology and try to compete with it ([Parkinson, 1985](#); [Robertson & Gatignon, 1998](#); [Verona, 1999](#)). Thus, firms such as Natsteel, IBM, and Microsoft pursue internal R&D for core NPD tasks. Core NPD tasks are usually associated with the firm's intangible assets. If the firm externalizes these tasks, it will leave the intangible assets unprotected. [Veugelers and Cassiman \(1999\)](#) study NPD in Belgian manufacturing firms and find that these firms seldom give important tasks to other firms. This leads to the following hypothesis:

**Hypothesis 1.** The importance of NPD tasks is negatively related to black-box integration with suppliers in NPD.

### 2.4. Complexity of tasks and black-box supplier integration

[Griffin \(1997\)](#) uses the number of functions of a product to describe its complexity. Others use difficulty to manufacture, sophistication, newness to the firm, or length of development time, if performed



**Fig. 1.** The research framework.

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