



## On the relationship between supplier integration and time-to-market

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### ABSTRACT

Recent operations management and innovation management research emphasizes the importance of supplier integration. However, the empirical results as to the relationship between supplier integration and time-to-market are ambivalent. To understand this important relationship, we incorporate two major recent developments. First, the literature has started to redefine supplier integration into two dimensions, supplier product integration and supplier process integration. Second, recent research has begun to examine spillover effects that extend beyond the direct costs and benefits of the supplier contract. Using survey data of 116 firms in the industrials, health care, and information technology industries, the results confirm our hypotheses and show that supplier product integration decelerates time-to-market while supplier process integration accelerates time-to-market. The results also show a positive relationship between supplier integration and the adoption of external technologies, which either decelerates or accelerates time-to-market depending on the level of internal exploration activities. Our research, thus, helps to open the ‘black-box’ of the relationship between supplier integration and time-to-market, and provides a theoretically grounded explanation to the apparent contradictory results in prior research about the influence of supplier integration on time-to-market. In addition, we contribute to research on spillover effects by emphasizing that information technology adoption and assimilation is an important spillover effect of supplier integration.

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### 1. Introduction

Time-to-market is an important driver for sustainable competitive advantage (e.g., Datar et al., 1997; Kessler and Chakrabarti, 1996). Short time-to-market allows firms to gain competitive advantage through higher market shares (Carpenter and Nakamoto, 1989), increased resource efficiency (Eisenhardt and Tabrizi, 1995), premium prices, and greater customer loyalty (Droge et al., 2000). Recent operations management and innovation management research highlights the importance of supplier integration in accelerating time-to-market (e.g., Appleyard, 2003; Petersen et al., 2003, 2005; Primo and Amundson, 2002; Van Echtelt et al., 2008).

Supplier integration refers to the involvement of suppliers in organizations’ innovation processes, as well as the execution of holistic innovation tasks, such as the development of components or subassemblies (Koufteros et al., 2005). Organizations may integrate suppliers to gain various benefits, such as resources and

capabilities, to accelerate time-to-market, improve innovativeness, reduce production costs, and enhance quality (Liker and Choi, 2004). The integration of suppliers is also associated with transaction costs, such as contracting, monitoring, and enforcement (Dyer and Singh, 1997; Williamson, 1985), as well as other related costs, such as coordination costs (Das et al., 2006). Supplier integration, thus, entails both potential costs and benefits that together determine the overall effect of supplier integration on time-to-market. Therefore, it is not surprising that Primo and Amundson (2002) point out that the literature provides opposing results about the benefits of supplier integration on new product development. The literature is especially inconclusive regarding the overall influence of supplier integration on time-to-market (e.g., Primo and Amundson, 2002; Ragatz et al., 1997).

The importance of clarifying how supplier integration influences time-to-market is accentuated by two major developments in the operations management and innovation management literatures. First, the literature has started to redefine supplier integration into two dimensions, supplier product integration and supplier process integration (Koufteros et al., 2005, 2007). In supplier product integration, suppliers “carry out product engineering activities on behalf of their customers and even develop components or entire subassemblies” (Koufteros et al., 2005, p. 102). In supplier process integration, “the supplier’s engineers work alongside the

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customer's engineers to jointly design the product so that the supplier's process can be effectively integrated with the design" (Koufteros et al., 2007, p. 864). Both integration types have different integration and knowledge requirements and thus dissimilar costs and benefits that may affect time-to-market differently.

Second, Mayer (2006) recently emphasizes that supplier integration may generate additional spillover effects that extend beyond the direct costs and benefits of the supplier contract. We examine the effect of one such spillover benefit, the adoption and assimilation of technology, on time-to-market. Technology in the operations context is "technical knowledge, or ('know-how'), applied to improve an organization's ability to provide products and services. Because technical knowledge varies widely in degree of physical embodiment, a specific technology could be a machine, an electrical or mechanical component or assembly, a chemical process, software code, a manual, blueprints, documentation, operating procedures, a patent, a technique, or even a person" (Stock and Tatikonda, 2000, p. 720).<sup>3</sup>

According to the information technology adoption and assimilation (ITAA) literature, to benefit from technology innovations, organizations first go through an initiation stage, in which they become aware of and evaluate the technology. This is followed by an adoption stage, where firms decide whether to acquire the technology, as well as a routinization stage, in which the acquired technology is embedded in the organization by overcoming learning barriers (Zhu et al., 2006). We propose that supplier integration provides firms with knowledge of external technology innovations and the opportunity to assess these innovations (e.g., Handfield et al., 1999), which leads to adoption. Based on the ITAA literature, we make a clear distinction between the sourcing of external innovation components and innovation processes (supplier integration) that provides the *opportunity* to firms to adopt external discoveries and the actual *adoption* of external discoveries (external technology adoption).

We further argue based on the ITAA literature that while the adoption of new technologies is an important stage, organizations have to use these technologies to improve innovation performance (Devaraj and Kohli, 2003). As routinization requires organizational learning, the more capable organizations are at overcoming learning barriers, the more they benefit from adopted external technology (Fichman and Kemerer, 1997). Based on Fichman and Kemerer (1997) and the organizational learning literature (e.g., Inkpen, 2000; Cassiman and Veugelers, 2006; Bstieler and Hemmert, 2010), we argue that internal exploration activities facilitate the routinization of adopted technologies. Hence, we examine whether the relationship between external technology adoption and time-to-market is moderated by the extent of the organization's internal exploration activities. We, thus, propose that external technology adoption, together with internal exploration activities, has a moderated-mediation effect on the relation between supplier integration and time-to-market.

Building upon this discussion, we formulate the following three research questions: (1) How do supplier product integration and supplier process integration act as antecedents to time-to-market? (2) Does external technology adoption mediate these relationships? (3) Does the extent of internal exploration activities moderate the impact of external technology adoption on time-to-market?

<sup>3</sup> While the majority of the spillover effect from the supplier is likely to be related to technology that is used to directly improve production capabilities, it may also include technology that indirectly improves the buyer's ability to provide products and services, such as enterprise software (Russel and Hoag, 2004), RFID (Ranganathan and Jha, 2005), web enabled supply chain management systems (Ranganathan et al., 2004), e-business technologies (Hsu et al., 2006), agile development (Martin, 2003; Cockburn, 2006), and open innovation (Chesbrough, 2003).

Using survey data in the industrials, health care, and information technology industries, we empirically examine the associations between supplier integration strategies and time-to-market. Given the opposing results in prior research about the benefits of supplier integration on new product development, it is interesting to note that our results show that supplier product integration decelerates time-to-market while supplier process integration accelerates time-to-market.<sup>4</sup> Our results also indicate that supplier product integration and supplier process integration increase external technology adoption. Further, we find that the effect of external technology adoption on time-to-market depends on the level of internal exploration activities. Thus, when examining the effect of supplier integration on innovation outcome variables, such as time-to-market, it is important to consider the specific type of supplier integration, i.e., product vs. process. In addition, it is important to take into account technology spillover effects to fully understand how supplier integration affects time-to-market.

This research contributes to operations management research by examining the relationships between two dimensions of supplier integration and time-to-market. Further, the paper improves our understanding of *how* supplier integration is related to time-to-market, i.e., this research helps to open the 'black-box' of the relationship between supplier integration and time-to-market, by examining the mediating effect of external technology adoption and the moderating effect of internal exploration activities. In addition to contributing to the understanding of antecedents to an important innovation outcome variable, time-to-market, these findings are important as they provide a theoretically grounded explanation to the apparent contradictory results in prior research about the impact of supplier integration on time-to-market. We also contribute to research on spillover effects by proposing and showing that technology adoption and assimilation is an important spillover effect in supplier integration. By leveraging the ITAA literature in our research we also suggest that this literature might provide a valuable foundation for future operations management research that focuses on technology assimilation, such as Lanzolla and Suarez (2012).

Our research contributes to practice by indicating that supplier integration does not per se lead to improved time-to-market. When sourcing innovation activities, the resulting success in terms of time-to-market is dependent on the type of sourcing. We also show that both types of supplier integration have positive technology spillover effects, but that the value of these spillover effects in terms of accelerated time-to-market is contingent on the buyer also committing resources to internal exploration activities.

The remainder of the paper is organized as follows. We present the theoretical framework in the next section, including the development of hypotheses. The following section describes the empirical study, including survey design, common method variance analyses, as well as construct validity and reliability tests. This is followed by a presentation and discussion of our results. We then highlight conclusions, important managerial implications, limitations, and future research.

## 2. Theoretical framework

### 2.1. Supplier integration, external technology adoption, and time-to-market

To understand the relations among supplier integration, external technology adoption, and innovation performance we turn to the ITAA literature. This literature describes how new technology

<sup>4</sup> Time-to-market is reverse coded, i.e., a positive effect on time-to-market accelerates time-to-market.

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