

The impact of IT on supply chain agility and firm performance: An empirical investigation



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ABSTRACT

This study investigates the impact of information technology (IT) on supply chain agility measured by the ability to sense and respond to market changes, and the impact supply chain agility has on firm performance. Data were collected from supply chain executives at 193 U.S. manufacturing firms. The results suggest that IT improves the supply chain's ability to sense market changes by improving the adequacy, accuracy, accessibility, and timeliness of the information flows among members of the supply chain. IT also increases the supply chain's ability to respond to market changes by reducing the cost, and improving the quality and timeliness of developing and executing coordinated plans to respond to market changes throughout the supply chain. Importantly, the results indicate that enhanced supply chain agility has positive impacts on the firm's sales, market share, profitability, speed to market, and customer satisfaction.

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1. Introduction

Firms today face the disruptive impacts of global competition, rapidly changing customer demands, and an accelerated pace of technological change that make the abilities to sense and respond to market changes critical core competencies (Ganguly, Nilchiani, & Farr, 2009; Overby, Bharadwaj, & Sambamurthy, 2006; Sambamurthy, Bharadwaj, & Grover, 2003). These competencies are even more important to firms that must identify and communicate market changes, and orchestrate coordinated responses to these changes throughout an integrated supplier chain (Christopher, 2000; van Hoek, Harrison, & Christopher, 2001).

These core competencies are captured in the concept of 'agility' (Ganguly et al., 2009; Sharifi & Zhang, 1999). Agile firms are quick to sense market changes, and execute coordinated responses that can achieve critical first-mover and other competitive advantages over rivals (Yusuf, Sarhadi, & Gunasekaran, 1999; Zhang & Sharifi, 2000). The information, communication, and coordination advantages of IT contribute to the agility that makes it possible to identify and coordinate supply chain responses to market changes (Goldman, Nagel, & Preiss, 1995; Hagel & Singer, 1999; Moore, 2000; Rayport & Sviokia, 1995; Sambamurthy et al., 2003; van Oosterhout, Waarts, & van Hillegersberg, 2006; Venkatraman & Henderson, 1998).

Advancements in information, communication, and coordination technologies have motivated numerous studies of IT's role in increasing agility (Kassim & Zain, 2004; Overby et al., 2006; Power, Sohal, & Rahman, 2001; Sambamurthy et al., 2003; Tallon & Pinsonneault, 2011; van Oosterhout et al., 2006). However, there are few empirical studies of the specific impacts of IT on supply chain agility, and firm performance (Swafford, Ghosh, & Murthy, 2008; Vickery, Droge, Setia, & Sambamurthy, 2010). Firms can realize substantial benefits from investment in IT that improve agility. Firms that lack agility can ultimately suffer losses in market share and profitability (Ganguly et al., 2009; Lee, Padmanabhan, & Seungjin, 2004). The purpose of this study is to advance understanding of IT's role in increasing agility throughout the supply chain, and ultimately impacts of investment in IT that increase agility on financial and operating performance.

2. Conceptual background

The concept of agility originated in the manufacturing sector in the early 1990s as a strategy for responding more effectively to a changing competitive landscape (Goldman, Preiss, Nagel, & Dove, 1991). Today, the term is often applied to firms that adapt to and perform well in rapidly changing environments (Dove, 2001; Sambamurthy et al., 2003; Weill, Subramani, & Broadbent, 2002). Thus, agility is commonly described as the ability to sense and respond to environmental changes in a timely manner (Li, Goldsby, & Holsapple, 2009; Mathiassen & Pries-Heje, 2006; Overby et al., 2006; van Hoek et al., 2001; van Oosterhout et al., 2006). It is also recognized that effectively responding to these environmental

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changes often extends beyond the single firm, requiring a coordinated supply chain strategy (Christopher, 2000; van Hoek et al., 2001). IT can be especially effective when deployed to identify, collect, analyze, and communicate market information, and to coordinate responses to this information with firms throughout the supply chain. IT thus plays a critical role in orchestrating a coordinated supply chain response by enhancing firms' abilities to sense and respond to market changes.

2.1. Role of information quality in sensing market changes

The abilities to sense market changes quickly and accurately and to share this information with firms throughout the supply chain, are critical to firms that create competitive advantage by leveraging the capabilities and resources of an integrated supply chain. The quality of the information communicated throughout the supply chain is the basis for coordinated decision making and action (Lummus & Vokurka, 1999; Min et al., 2005; Price & Shanks, 2005; Sellitto, Burgess, & Hawking, 2007; Simatupang & Sridharan, 2008; Stank, Keller, & Daugherty, 2001; Stvilia, Gasser, Twidale, & Smith, 2007; Whipple & Russell, 2007). IT can play an important role in this coordinated decision making by managing large amounts of data on market changes that must be distributed, assimilated, and leveraged throughout the supply chain.

By facilitating the flow and processing of information across the supply chain, IT can improve the timeliness, accessibility, accuracy and adequacy of information. (Christopher, 2000; Vickery et al., 2010) These improvements in the quality of information flows throughout the supply chain have only been achievable through developments in IT, and are one of the main drivers for IT use (Auramo, Kauremaa, & Tanskanen, 2005; Barratt, 2004; Miller, 1996; Nath & Standing, 2010). As a result of IT, the entire supply chain is able to easily share useful and accurate information (Hartono, Li, Na, & Simpson, 2010).

2.2. Role of collaboration in responding to market changes

Supply chain collaboration is increasingly recognized as an important source of competitive advantage as firms are required to work together more closely to meet the challenges of uncertain and volatile markets (Dyer & Singh, 1998; Fiala, 2005; Petersen, Ragatz, & Monczka, 2005; Thun, 2010; Yusuf, Gunasekaran, Adeleye, & Sivayoganathan, 2004). Collaboration enables a firm to achieve a level of agility not obtainable on its own by leveraging the entire supply chain to respond more effectively to market changes (Christopher & Towill, 2001; Kulp, Lee, & Ofek, 2004; McCarthy & Golicic, 2002; van Hoek et al., 2001). By collaborating with its suppliers, a firm can improve its ability to align supply and demand while ensuring costs are under control (Barve, 2010). This, in turn, enables firms in the supply chain to capitalize on market opportunities ahead of competitors.

IT has emerged as a major driver and enabler of supply chain collaboration through its ability to allow large amounts of information to be shared along the supply chain quickly (Kumar & van Dissel, 1996; Marquez, 2010; Sambamurthy et al., 2003; Sanders, 2007; Yusuf et al., 2004). IT can improve the ability of firms in the supply chain to work together more effectively to develop and implement coordinated responses to market changes in a timely, accurate, and cost effective manner (Porter, 1991; Prahalad & Hamel, 1990; Teece, Pisano, & Shuen, 1997; Yusuf et al., 2004). Simatupang and Sridharan (2002, p. 19) maintain that "A collaborative supply chain means that two or more independent companies work jointly to plan and execute supply chain operations with greater success than when acting in isolation."

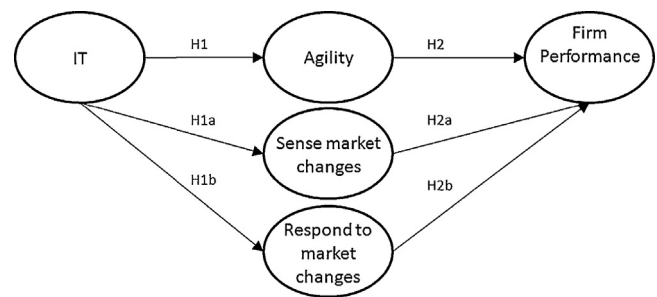


Fig. 1. Research model.

3. Research model and hypotheses

The research model for this study is shown in Fig. 1. The model empirically tests the impact of IT on supply chain agility measured by (1) the ability to sense market changes and, (2) the ability to develop and execute coordinated plans throughout the supply chain to respond to these changes. The research model also tests the impact of enhanced agility on the firm's financial (sales, market share and profitability) and operating (speed to market and customer satisfaction) performance.

3.1. Impact of IT on supply chain agility

The literature consistently supports that IT has a positive impact on supply chain agility (Bottani, 2010; Overby et al., 2006; Power et al., 2001; Swafford et al., 2008; Tallon & Pinsonneault, 2011; Yusuf et al., 2004; Zain, Kassim, & Mokhtar, 2003). IT significantly enhances the firm's ability to capture, process, and share large amounts of information across the supply chain and to coordinate intra- and inter-organizational processes thereby improving the supply chain's effectiveness (Vickery et al., 2010). An essential technology leveraged by firms to coordinate their supply chain operations is the Enterprise Resource Planning (ERP) system (Wailgum, 2008). ERP systems can increase the supply chain's ability to respond to the market faster by reducing lead and cycle times, increasing flexibility and information accuracy, and improving supplier performance and customer service (2008). In addition to ERP systems, firms utilize supply chain management software, web portals, e-applications, EDI, data warehousing, and other communication technologies to execute supply chain processes, and to communicate throughout the supply chain. Therefore, we expect IT to increase the agility of the supply chain as stated in our first hypothesis:

H1. IT increases supply chain agility.

3.2. Impact of IT on sensing

IT's impact on supply chain agility in this study consists of two components: sensing and responding to market changes. Sensing market changes is defined as the quality of information on market changes communicated throughout the supply chain. The literature provides various definitions of information quality, however, 'fitness for use' is the most prevalent (Ballou, Madnick, & Wang, 2003; Petersen, 1999; Wang & Strong, 1996). This definition assesses the quality of information from the user's perspective (Ballou et al., 2003; Petersen, 1999). IT improves the timeliness, accessibility, accuracy and adequacy of information that are all critical to those who use this information throughout the supply chain (Christopher, 2000; Vickery et al., 2010).

The literature also finds that the quality of information shared in the supply chain is critical to decision-making effectiveness (Gorla, Somers, & Wong, 2010; Khalil, 2005; Petersen et al., 2005; Price &

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