



The effects of technological turbulence and breadth on supply chain technology acceptance and adoption

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ABSTRACT

The current empirical study examines the intention to use and subsequent implementation of a supply chain technology. Specifically, the authors extend the technology acceptance model (TAM) to incorporate the state of the technology environment (technological turbulence) and the extent to which other supply chain technologies have already been adopted by the firm (technological breadth). A series of seemingly unrelated regressions (SUR) were used to analyze survey data from 195 respondents. The results show that in technologically turbulent environments, the relationships between the firm's perceived usefulness and ease of use and the firm's intention to use a supply chain technology are stronger. The study also finds that the relationship between the firm's intention to use a supply chain technology and the implementation of the technology is weaker in firms with greater technological breadth.

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1. Introduction

With the sheer number of technological introductions in recent years, firms simply cannot implement every new technology that comes along. As Closs et al. (1997) noted, there are “numerous examples where information technology extensions have wasted firm resources” (p. 4). Other researchers (e.g., Lucas, 1999; Sriram and Stump, 2004; Tippins and Sohi, 2003) have pointed out that a technology productivity paradox exists, meaning there is inconsistent evidence that information technology investments lead to significant increase in firm productivity (Richey et al., 2008a). Therefore, a critical challenge for operations managers is assembling the right grouping or portfolio of technologies to accomplish firm objectives. This challenge is especially daunting given the uncertainties caused by rapid technological development in many industries, and the fact that many firms are already overburdened with broad technological portfolios that must be managed by limited staff.

Much of the existing research addressing technology usage focuses on acceptance and adoption by individual users, e.g., the technology acceptance model (TAM) (Davis, 1989; Parasuraman, 2000) and the theory of reasoned action (TRA) (Fishbein and Ajzen,

1975). However, research addressing organizational-level acceptance of technologies remains scant in the literature – there are few studies examining group-level attitudes and perceptions that predict technological utility for the firm rather than the individual employees working within it. The current study addresses this void by exploring the organizational-level attitudes toward, and subsequent implementation of, a single class of technologies: those used for supply chain management. Supply chain technologies are considered to be critical facilitators of business performance, given that effective supply chain management requires operational coordination between/among supply chain partners (Narasimhan and Jayaram, 1998; Sanders, 2005). In fact, as Sanders (2005) is careful to note, supply chain management has been “particularly impacted by the growth and development of information technology” (p. 4).

This article addresses gaps in current theory related to technology acceptance and adoption that are inherent to the supply chain technology context. The extant technology acceptance/adoption theoretical frameworks at the organizational-level include social network theory (Gibbons, 2004) and the diffusion of innovations framework (Rogers, 2003). These models, however, do not consider the antecedent attitudes and related behaviors of technology user groups. As a result, we approach the issues of supply chain technology acceptance and adoption from the TAM theoretical perspective. In doing so, our study makes two key contributions to the literature. First, it examines the outcomes of common supply chain technology perceptions held by users—a factor that has been shown to

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significantly impact individuals' acceptance and adoption of technology in other settings (Venkatesh and Bala, 2008). Second, it extends the TAM level of analysis to examine the firm itself as the user of supply chain technology.

In the following sections, a theoretical framework is presented and research hypotheses are developed, linking organizational-level supply chain technology acceptance with behaviors reflecting organizational adoption of the technologies. Within the framework, specific attention is given to the impacts of two important contingencies associated with knowledge-based absorptive capacity for technology thought to be particularly troublesome for supply chain technology acceptance and adoption: the turbulence of technology within the firm's core industry, and the relative breadth of its own technology portfolio. Subsequently, we provide discussion of a robust empirical research methodology, introduce measures, and conduct hypothesis testing. Finally, results are presented and discussed along with limitations of the research and suggestions for future research extensions.

2. Theoretical background and research hypotheses

Supply chain management is primarily concerned with both cross-functional and interorganizational integration of business processes and relationships (Bowersox et al., 2000). Technologies (2009) (per the Merriam-Webster dictionary, 2009) are any collection of applied tools and machines that may be used to solve real-world problems. Synthesizing, we view *supply chain technologies* as applications that support integrated supply chain management processes between functional units, either within or across firms. We specifically define supply chain technologies as *the tools and/or techniques that may be implemented in order to effectuate integrated supply chain management within or across organizational boundaries*. Various types of supply chain technologies exist for the purposes of effectively managing supply chain operational processes and relationships (Kosansky and Schaefer, 2009; Patterson et al., 2004; Turetsky, 2008). These range from low-level/operational technologies such as barcoding, through mid-range tactical technologies designed to enhance logistics/supply chain functionality (i.e., Warehouse Management Systems, Transportation Management Systems), and so on through strategic level technologies and systems designed to address ongoing, long-term supply chain process integration and planning, and interfirm relationships (i.e., Collaborative Planning Forecasting and Replenishment, visibility-oriented technology programs, etc.) (Autry et al., 2005). The wide assortment of supply chain technologies challenges firms to perpetually evaluate the emerging technologies available in the market and in use by both competing and partnering firms (Ranganathan and Sethi, 2002). Furthermore, firms are often encouraged by their supply chain partners to employ specific technologies, and the variety of technologies available for consideration is typically characterized by continuous and rapid change (Carr, 2003; Jones, 2003).

The technology acceptance model provides the core theoretical framework for the current study of supply chain technologies. Since its introduction 20 years ago (Davis, 1989), TAM has received a great deal of attention in the operations management and business strategy literatures (Boyer and Olson, 2002; Ilie et al., 2009; Olson and Boyer, 2003; Venkatesh and Bala, 2008). The framework was introduced and has developed in business literature. Since its introduction, the original TAM articles have been cited over 5000 times (Venkatesh and Bala, 2008). TAM seeks to explain the relationship between two related but discrete concepts – the individual's technological acceptance and adoption – thereby linking users' cognitive approval of technology features to their behavioral intention to use it, and subsequently to actual implementation.

TAM proposes that two cognitive factors determine an individual's technological acceptance: perceived usefulness of the technology and its perceived ease of use. If a technology under consideration is assessed favorably based on these criteria, adoption should follow. Repeated testing of TAM has shown that these factors consistently explain 40% of the variance in individuals' intention to use (acceptance) and subsequent implementation (adoption) of a technology (Venkatesh and Bala, 2008). The basic framework has more recently been expanded (i.e., TAM2 and TAM3) to include broad categories of antecedents to the perceived usefulness and perceived ease of use cognitions, such as individual differences, system characteristics, social influences, and facilitating conditions (Igbaria et al., 1997; Karahanna et al., 2006; Lin et al., 2007; Saade and Bahli, 2005; Venkatesh, 2000; Venkatesh and Bala, 2008; Venkatesh and Davis, 2000; Wixom and Todd, 2005).

Our extension of TAM to the organizational-level allows us to examine firmwide acceptance and adoption of specific supply chain technologies, which is an important consideration for operations managers. This analysis begins with an understanding that at the organizational-level, individuals act and make decisions on behalf of the organization. It is generally accepted that senior and middle-level executives influence the extent and manner in which organizational policies are enacted (Staw, 1991). As Boyer and Olson (2002) note, "it is extremely difficult to separate individual differences from company to company differences, particularly since individuals serve as technology champions, users, and shapers of corporate policies" (p.484). Staw (1991) seminally noted that "organizational actions are actually individual behaviors" (p. 807), suggesting support for the use of psychological theories to explain organizational behaviors. Thus, we expect that the key postulates of the individual-level TAM will be relevant at the group (organizational) level as well. However, we do recognize that organizational decisions regarding supply chain technology implementation may also consider additional factors beyond individual-level acceptance such as cost, availability, or brand reputation. The existing general TAM framework indirectly accounts for these contingencies by examining specific perceptions of usefulness – productivity, effectiveness, and real and perceived performance – each of which is impacted by characteristics of the supply chain technology that may or may not be included in individual-level perceptions or decision making. We investigate the linkages between group-level supply chain technology attitudes, acceptance, and adoption through our research hypotheses in the forthcoming sections.

2.1. TAM and supply chain technologies

Only a few empirical studies were identified that examine technology-acceptance-related issues at the firm or organizational-level. Boyer and Olson (2002) examined ways in which companies used the Internet to streamline the purchasing process. They surveyed purchasing agents to assess the priorities and objectives that drive companies to adopt Internet purchasing. Areas covered in the questions to the purchasing agents included "the reasons companies chose to employ Office Depot's web site" and "elements of a company's culture that affect its usage of Internet purchasing" (p. 488). Thus, the purchasing agents were, in effect, speaking for their companies. Similarly, Richey et al. (2008b) explored the impact of retailer technology utilization behaviors on retailer operational effectiveness. Their assessment of retailer technology use and effectiveness was based upon survey data collected from the executives (individuals) responsible for technological implementation at the retail firms.

For the most part, existing TAM-related empirical studies have been limited to the technology acceptance-related issues of individual users (e.g., Lin et al., 2007). With a few exceptions (e.g.,

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