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The use of information technology tools in new product development phases: Analysis of effects on new product innovativeness, quality, and market performance

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ABSTRACT

Extant research has largely ignored empirically examining how information technology (IT) affects new product effectiveness. Using the knowledge-based theory as a foundation, this study examines if, and how, particular IT tools used in the discovery, development, and commercialization phases of the new product development (NPD) process influence NPD effectiveness dimensions, namely, market performance, innovativeness, and quality of a new product. Based on data collected from NPD managers in the US and Canada, the findings indicate that specific IT tools contribute to various measures of new product effectiveness differently. Moreover, the results show the positive effect of these IT tools in different phases of the NPD process. This suggests that with regard to NPD, a decompositional approach that examines the role of IT within each phase of the NPD process is best. Based on these findings, the authors discuss theoretical and managerial implications of the study and suggest paths for future research. Managerially, some interesting results of our study are that decision support systems, file transfer protocols, and concept testing tools would significantly improve NPD effectiveness regardless of the phase they are used.

1. Introduction

The competitiveness of U.S. firms in the 21st century global economy depends on their ability to develop and deliver innovative products and services (Alliance for Science and Technology Research in America, i.e., ASTRA, 2007). However, new product success rates continue to remain around 60% and only about 50% of commercialized new products are successful from a profit perspective (Barczak, Griffin, & Kahn, 2009). In recent years, a declining trend has also been observed with regard to the percent of sales and profits accounted for by new products with less than one third of sales and profits coming from new products (Barczak et al., 2009). This reality has led to firms' continuing to search for ways to improve their new product development (NPD) efficiency (e.g., reduced cost, faster time-to-market) and effectiveness (e.g., higher new product quality, greater market success).

One way to potentially improve NPD outcomes is to utilize information technology (IT) tools (Nambisan, 2003). In fact, more than 90% of senior executives surveyed by Accenture believe that IT enables innovation (O'Mahony, Padmore, & Suh, 2003). Fueled by this belief, companies are increasingly using IT to support and enhance their NPD process (Cooper, 2007). However, there is limited empirical research validating the numerous assertions about the positive effect of IT use on NPD outcomes (e.g., Dewett & Jones, 2001). The goal of this paper is to address several gaps in this area.

First, extant research fails to investigate the influence of specific IT tools on new product performance. For example, it is argued that IT use supports collaboration, coordination, and communication amongst NPD team members (Dewett & Jones, 2001; McGrath & Iansiti, 1998; Nambisan, 2003; Durmusoglu, 2009) or enhances the base of knowledge available to an NPD team (Dewett & Jones, 2001). However, due to the proliferation of IT tools available, it is important for managers to know which IT tools provide value.

Second, the majority of prior research proposes that IT tools affect efficiency measures (e.g., cost and time-to-market) and say little about the potential effect of IT use on effectiveness measures such as new product quality, product innovativeness, and/or market performance.[1] Notwithstanding the importance of efficiency outcomes in NPD efforts, the ultimate test of a new product is how it is viewed by customers (i.e., is it unique; is it of high quality?) which in turn, affects the product's performance in the marketplace. Moreover, investigation of the effect of IT tool use should include multiple effectiveness

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[1] See Banker et al. (2006), which finds that product lifecycle management systems indirectly affect product quality and Barczak et al. (2007), which finds that IT use is positively related to the new product market performance, for exceptions.

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measures because various NPD outcomes may be more amenable to different IT tools (Rangaswamy & Lilien, 1997).

Third, to date, limited empirical evidence exists on what IT tools influence the performance of new products in different phases of the NPD process. The use of various IT tools is likely to change over time during the life of an NPD project (Pavlou & El Sawy, 2006). Put another way, NPD projects are dynamic, resulting in different IT tools being used in diverse phases of the NPD process and affecting each phase differentially (Boutellier, Gassman, Macho, & Roux, 1998; Kessler, 2003; Malhotra & Majchrzak, 2004). Thus, understanding the role of IT across distinct phases of the product development process is an important area for research (Banker, Bardhan, & Ozer, 2006).

In this study, we focus on the use of specific IT tools in different NPD phases and contribute to the literature in three ways. First, drawing from previous qualitative interviews with NPD personnel and from the literature, we investigate the impact of eleven IT tools, namely, e-mail, web meetings, product design software, decision support systems (DSS) for project evaluation, idea generation software, shared drives/project rooms, file transfer protocols, secondary data, virtual prototyping, concept testing software, and online needs surveys, on NPD outcomes.

Next, building on the notion that IT helps to create an innovation capability that results in creating business value (e.g., Bharadwaj, 2000; Sambamurthy & Zmud, 2000; Weill, Subramani, & Broadbent, 2002), this research moves beyond examining how IT enhances the efficiency of the NPD process to investigating the question of whether or not IT enhances NPD effectiveness. We focus on new product innovativeness, quality, and market performance, which are frequently used NPD effectiveness measures.

Finally, this study examines the usage of different IT tools across various phases of the NPD process. More specifically, this research examines the effect of particular IT tools in the discovery, development, and launch phases of the NPD process on new product effectiveness. A decompositional approach to investigating the factors that affect the NPD process is appropriate because prior research suggests that the stage that an NPD project is in is important to examine because the effects of causes on outcomes are different in the initial stages as compared to later stages (Griffin & Hauser, 1996; Madhavan & Grover, 1998). Further, with regard to IT, case studies show that different IT tools are used in various stages of the NPD process (Boutellier et al., 1998; Malhotra & Majchrzak, 2004).

The remainder of this paper is structured as follows. First, the three NPD process phases are described and theoretical support for each hypothesis is presented. Specifically, this research explores whether twelve frequently used IT tools in each of these three phases foster new product quality, product innovativeness, and/or market performance. Then, the data collection method, measurement, and construct reliability and validity are delineated, followed by the presentation of the analysis and results. The paper ends with a discussion of the findings, theoretical and managerial implications followed by limitations and future research directions.

2. Theoretical background and hypotheses development

2.1. NPD process phases

NPD is a risky and uncertain process (Cooper, 2001); so to facilitate development efforts, most firms use a formal NPD process (Barczak et al., 2009). In a formal NPD process, a new product idea moves through a series of activities from inception to launch and gates at the end of a subset of activities serve as critical go/no go decision points (Cooper, 1994, 2001). While the total set of activities for bringing an idea to market are to a large extent the same across firms, there are various segmentations of the NPD process into certain phases. In this study, we adopt a three-phased decomposition, namely, discovery (i.e., fuzzy front end), development, and commercialization, as recommended by the Product Development Management Association (PDMA) and used in recent work (e.g., Lagrosen, 2005, Frisjammar & Ylinenpaa, 2007; Cooper, 2008).

The discovery phase entails identifying market opportunities, collecting and analyzing customer requirements, generating product/service ideas that tie the opportunities with customer needs, testing product concepts with customers, developing a clear description of the selected product requirements, and setting of budget and schedules. In general, investments in the discovery phase allow NPD teams to generate and assess various new product opportunities and ideas before large amounts of resources are committed to those ideas. In addition, technical and non-technical issues can be addressed early in the process, thereby avoiding delays and significant problems later in the process. The second phase, development, involves the translation of the product requirements and specifications that were defined into a final design, which is then converted into a concrete product ready for commercialization. This phase also involves testing of the product, both internally and with customers. In the final phase, commercialization, formulation, execution, and synchronization of the launch are performed. During commercialization, production ramp up, training of the distribution and sales forces, purchasing of media time/space, and development of media messages are also carried out. Scholars have argued and found evidence that firms that possess the capability of proficiently executing the tasks in NPD phases have better new product performance (e.g., Henard & Szymanski, 2001), thereby rendering the resource-based view as the appropriate theoretical foundation for our study.

2.2. The knowledge-based view

The resource-based view (RBV) suggests that firms have different resources and capabilities and that performance depends on how those particular resources and capabilities are deployed (Wernerfelt, 1984). According to this perspective, a firm's resources and capabilities can include IT (Barney, 1991). Hence, scholars argue that technological capabilities are among the important drivers of product development outcomes (Verona, 1999) and that managers' ability to conceive, implement, and exploit IT applications to support and enhance firm activities such as NPD, can provide potential competitive advantage (Mata, Fuerst, & Barney, 1995; Sambamurthy & Zmud, 2000).

Originating from the RBV, the knowledge-based view (KBV) posits that knowledge is a unique resource and that firm performance depends on how well organization members can enhance the firm's knowledge base, integrate different knowledge areas, and apply the knowledge to the development of new products (Grant, 1996; Kogut & Zander, 1992; Nonaka, 1994; Spender, 1996). The activities within each NPD phase require the collection, analysis, and integration of new information and knowledge from within the team as well as sources outside the team (e.g., customers, competitors, suppliers) (Cooper, 2001). Since IT use can facilitate knowledge accumulation, examination, and dissemination in NPD (e.g., Banker et al., 2006; Boutellier et al., 1998; Malhotra & Majchrzak, 2004; Song, Berends, Van der Bij, & Weggemen, 2007), the KBV enables us to expect that the use of IT tools would improve NPD effectiveness as elaborated in the hypotheses that follow.

2.3. The effect of IT tools on new product development effectiveness

Computer-mediated communication technologies are IT tools that facilitate, intensify or expand the interaction of and communication between employees during NPD task executions such as planning, designing, decision making, or implementing (Song et al., 2007). E-mail and web meetings are among the most frequently used computer mediated communication technologies. These technologies allow for more frequent communication due to reduced cost, thereby enhancing information sharing and dissemination (Hameri & Nihtila, 1997).