



Evolution of the impact of e-business technology on operational competence and firm profitability: A panel data investigation



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ABSTRACT

This study examines the evolution of the impact of e-business technology on operational competence and profitability using a panel dataset of 154 Spanish firms. We find that (1) e-business technology has a positive effect on operational competence that decreases over time and (2) the firm's proficiency in exploiting a portfolio of operational capabilities has a positive impact on profitability that becomes more substantial over time. The findings provide some insights on how the initial and subsequent IT investments affect operational competence and profitability over time. This study methodologically illustrates how to perform a partial least squares estimation using panel data.

1. Introduction

Firms invest millions of Euros in information technology (IT) to build process capabilities and increase their competitiveness [1–4]. However, not all IT investments generate the expected results [5]. This situation demands managers to carefully (re)assess all their IT investments [6,7].

The majority of past research focused on IT impact on the supply chain and manufacturing activities through a cross-sectional design [8–13]. It remains unclear that whether and how IT investments impact a broader set of operational capabilities and performance over time. Considering that IT and operational capabilities along with their relationship and effect on firm performance can be dynamic, there seems to be a significant gap that needs to be filled in research in our field.

The present research focuses on e-business technology (one type of IT capability investment/resource allocation) and on whether, how, and under what conditions this capability creates business value. E-business technology can improve the firm's operations management system by enabling the real-time interchange of information across the supply chain [9,12]. However, e-business technology has become commoditized and can be affordable for most large firms, which can reduce its potential to create operational advantages over time [5]. This leads to our first research question: How does the time of investment in e-business technology affect the firm's operations management system

(specifically, operational competence comprising a portfolio of capabilities) over time? We believe that the Information Systems (IS) field needs to provide an answer to this critical research question. This is what we try to achieve in this research.

With regard to the firm's operations management system, we focus on the firm's operational competence, which refers to the firm's proficiency in exploiting its portfolio of operational capabilities [12,14]. This competence is related to the heart of the business model of a firm, which supposes a natural starting point in this research [15]. On the basis of the work of Tatikonda et al. [16], we focus on a portfolio of operational capabilities that determines operational competence: gross margin, employee productivity, operational talent management, and operational excellence. These operational capabilities are related to product margin control, productivity management, talent management, and manufacturing and service excellence; they are a good representation of the potential portfolio of operational capabilities that a contemporary firm may possess to be successful and survive in the long run [16].

The operational capabilities of the firm can be refined through time and experience. Early developers of operational capabilities through early investment in e-business technology can achieve greater competitiveness because of longer duration and experience in developing their operational capabilities. This leads to our second research question: Do initial and subsequent e-business technology investments result in

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differences in the operations management impact on the firm's competitiveness over time? We address the above two questions in this study. Specifically, by drawing on the IT-enabled organizational capabilities perspective [1,17–19], the operational capabilities-based theory [20,15], and the literature on the hierarchy of capabilities of the firm [8], the main goal of this study is to examine the evolution of the impact of e-business technology on operational competence and firm profitability over time. To achieve this goal, we use the structural equation modeling (SEM) technique with a panel dataset for the period 2008–2010 on a sample of 154 large firms in Spain. The empirical analysis suggests that the positive effect of e-business technology on operational competence decreases over time, while the positive effect of operational competence on firm profitability increases over time. The findings provide some insights on how the initial and subsequent IT investments affect operational competence and firm profitability over time. Early development of IT-enabled operational capabilities maximizes firm profitability because of the greater time and experience the firm has in developing its operational capabilities. Furthermore, this study methodologically illustrates how to perform a partial least squares (PLS) estimation using panel data.

2. Theory and hypotheses

2.1. Theoretical background

The IT-enabled organizational capabilities perspective has argued that one of the key mechanisms through which IT capability influences firm performance is by developing organizational/process capabilities, such as business flexibility, talent management, new product development, absorptive capability, and innovation capability [21–25]). This study builds on the IT-enabled organizational capabilities to conceptualize e-business technology and to theoretically link e-business technology to operational competence and firm profitability over time. We use a three-year panel data.

Operational routines are patterns of activities/processes that a firm performs at the operations level, which can lead to superior firm performance. Operational capabilities are the firm's proficiency in using a collection of interrelated operational routines to solve operational problems and implement the operations strategy [20,26,15]. The theory of operational capabilities provides a strong theoretical framework to conceptualize e-business technology and operational competence and to link these constructs both among themselves and to firm profitability.

This study also draws from the literature on the hierarchy of firm's capabilities (e.g., [27,8]), which is consistent with the IT-enabled organizational capabilities perspective and the operational capabilities-based theory. In the hierarchy of capabilities, lower-order capabilities require other higher-order capabilities to affect business outcomes (firm profitability in this case). In this sense, e-business technology is considered as a lower-order capability that requires operational competence (a higher-order capability) to affect firm profitability [28,22].

2.2. Conceptualization of e-business technology, operational competence, and firm profitability

E-business technology capability is the firm's proficiency in leveraging its web-based technologies to interchange within and outside the firm for buying and selling activities with suppliers and customers [9,10,29–33]). Operational competence refers to the firm's proficiency in exploiting its portfolio of operational capabilities [14,12]. On the basis of the work of [16], we focus on a portfolio of operational capabilities that determines operational competence: gross margin, employee productivity, operational talent management, and operational excellence. Gross margin is the firm's proficiency in managing/estimating proper product margins. Employee productivity refers to the firm's proficiency in stimulating the personnel to achieve higher

individual performance [34]. Operational talent management is the firm's proficiency in recruiting (sourcing, attracting, and selecting), getting on board, developing, and retaining operational talent [15]. Operational excellence refers to the firm's proficiency in developing and executing operational routines to manufacture/supply products agilely (in an excellent way) to the market [26,25]). This study focuses on firm profitability to assess the firm's business benefits. Fig. 1 presents the conceptual model showing the interrelationships among e-business technology, operational competence, and firm profitability over time.

2.3. E-business technology and operational competence

E-business technology can enable the development of operational competence by facilitating the improvement of gross margin, employee productivity, operational talent management, and operational excellence. E-business technology can enable the firm's proficiency in managing successful product margins. Web-based technology enables the firm to have real-time interchange of accurate and timely information on product cost and demand with upstream suppliers and downstream customers, thereby enabling the firm to better manage its product margins [9,10,22]. Similarly, e-business technology can also be leveraged to increase employee productivity [35]. The firm's web-based communication networks (e.g., email, Intranet) enable the employees to access and share more heterogeneous/diverse knowledge (e.g., information about the manufacturing process/other employees) and learn to perform multiple tasks, which increase employee productivity [36,37].

E-business technology can also improve the management of operational talent. Through e-business technology, the firm acquires/provides accurate and timely information from/to the market to recruit and get on board outstanding operational talent to design and integrate its talent base. For example, Cortefiel (an apparel manufacturer in Spain) uses web-based social media tools such as LinkedIn, Facebook, and Twitter to recruit operational managerial talent that fits the profile needed in designing its talent base [38]. Web-based technology enables the firm to implement scheduling and workplace flexibility activities to retain operational talent and to provide reliable information on goal completion, performance appraisal, and career planning to develop and retain operational talent [15]. Finally, leveraging web-based business applications (e.g., operational module of an enterprise resource planning) enables better execution of operational routines and agility in manufacturing/supplying products to the markets to pursue operational excellence [39,25]). We therefore hypothesize that

H1a. *E-business technology has a positive effect on operational competence.*

Firms may not need to invest substantially in IT every year/period. For example, Air Canada (the largest airline firm in Canada) invested in 2007 in its web-based technology to be the first airline in offering its customers the online boarding pass and self-service IT applications to save costs (increase gross margin) and improve operational excellence. After its initial investments in e-business technology, Air Canada did not need substantial additional investments in e-business technology to retain its operational development in the subsequent periods [40].

We also predict that the positive effect of e-business technology on operational competence can decrease over time for two reasons. First, additional investments in e-business technologies (after investments in prior periods) can diminish the operational marginal returns [37]. Second, e-business technology has been commoditized and can be affordable for most firms. Consequently, follower firms can learn to invest in e-business technology and develop e-business technology capability, which can convert e-business technology into a non-unique/imitable capability, and its effect on operational competence can decrease over time [5,41]. We therefore hypothesize that

H1b. *The effect of e-business technology on operational competence decreases over time.*

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