



A structural equation model for analyzing the impact of ERP on SCM

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ABSTRACT

Enterprise resource planning (ERP) and supply chain management (SCM) represent important information technology investment options for operation or IT managers, and have been acclaimed in the practitioner and academic literature for their potential to improve business performance. The purpose of this article is to provide further insights into the adoption of ERP systems and the impacts on firm competence in SCM. We propose a model featuring ERP benefits to firm competences in supply chain management. We also hypothesize that three constructs of ERP benefits positively impact firm competences in SCM. To clarify the relationships among these constructs, structural equation model (SEM) is conducted to examine the model fit and nine hypotheses. The SEM results clearly demonstrate that there exist close interrelations among the benefits of implementing ERP systems and firm competences in SCM. The data from Taiwanese IT firms was collected through interviewing of experts and surveys. The results provide empirical evidence that the beneficial impacts of ERP on the supply chain do lead to better overall SCM competence. That evidence confirms that operational benefits, business process and management benefits, and strategic IT planning benefits of ERP in turn enhance firm competences of SCM in operational process integration, customer and relationship integration, and planning and control process integration.

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1. Introduction

Business organizations today are facing a more complex and competitive environment than ever before (Chen & Lin, 2009a; Ellram, 1991). Business success is no longer a matter of analyzing only the individual firm, but rather the chain of delivering and supplying organizations; the individual firm is only a single part of the supply chain. Therefore, companies are focusing on supply chain strategies to streamline internal operations, boost plant productivity, improve product quality, and reduce manufacturing costs. One reason for these initiatives is the substantial cost reductions to be achieved by improving the firm competences of supply chain management. Another reason is the advent of the Internet economy. The internet is challenging the traditional supply chain structures that firms have employed to get goods and services to markets (Rahman, 2003). Markets are becoming more transparent; customer demands are being met in a more customized manner, and the rate of change in the business world keeps increasing (Ellram, 1991). All these developments are having a profound impact on the enterprises of supply chains. Therefore, how to enhance

the firm competences on supply chain management is becoming more important.

The literature on new business models for the Internet age is growing rapidly. In particular, Fine (1998) has pointed out that as the business environment changes, supply chain design is becoming a core competence. At the same time, another business-driven phenomenon, the adoption of enterprise resource planning (ERP), is sweeping across industry. Adoption of ERP systems may motivated by pressure from competitors, or by requests from partners or customers in the supply chain for linkage or system upgrades, or simply by the need to replace the legacy systems. When ERP systems are fully realized in a business organization, they can be expected to yield many benefits: reduction of cycle time; faster transactions; better financial management; the laying of the groundwork for e-commerce; and making tacit knowledge explicit. Since the potential benefits are large, many organizations are willing to undertake the difficult process of converting from whatever they currently use to an ERP system. Installing an ERP system is, however, an expensive and risky venture (Chen & Lin, 2009b; Markus & Yanis, 2000). Roach (1991) stated that although business was investing huge sums of money in IT, positive results could not yet be observed in the US economy. Strassman (1990) also failed to find positive returns from IT investments in his study of IT expenditures in the 1980s. Other researchers during this same time period found similar outcomes (Pentland, 1989). More recent,

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evidence, though, has, on the contrary, demonstrated large benefits from IT investments and uncovered significant productivity gains from IT. Other recent studies (Hitt & Brynjolfsson, 1996; Mukhopadhyay, Kekre, & Kalathur, 1995) have argued persuasively that enough evidence has been gathered on the positive effects of IT to justify the conclusion that ERP investment does pay off.

As reported in Chang et al. (2008), while the external environments and alliance partnerships facing an enterprise are becoming more complex, executive should enhance efficiency and performance of supply chain management as well as to gain potential competitive advantages. Although many academic researchers have contributed by confirming the relationship between supply chain competences and enterprise performance or by confirming the relationship between ERP benefits and enterprise performance, determining just how the ERP system was expected to work as an integral component in supply chain management has been less studied and is not understood. Our research, therefore, focuses on the impact of ERP benefits on the firm competences of SCM, rather than on the relationship between ERP or SCM and enterprise performance. From the above historical perspective, and after reviewing the selected literature on ERP and supply chains, we first listen to practitioners. What do experts from business, who recently have been or are currently going through ERP or SCM systems implementations, think about the strengths and weaknesses of ERP with respect to enterprises and SCM? The present study is based on the Taiwanese IT industry for two reasons: First, it has achieved outstanding results over the past two decades (Chang and Yu, 2001, chap. 12). “Made by Taiwan” (Taiwan-made) IT products dominate the worldwide market in many categories. Most of them dominate over 50% of the worldwide market. Many scholars have conducted research into the SCM of firms in some developed countries (Benton & Maloni, 2005; Lim & Palvia, 2001). These studies cover many types of industry, such as the chemical, pharmaceutical, bioengineering, automobile, etc. They also include a wide range of high-technology firms. The IT industry in developing countries, such as Taiwan, China, and Korea, has not, however, been comprehensively studied. Second, in the IT industry, product life cycle is extremely short. Companies need to deliver new products before they have any market value. In the Taiwanese IT industry, the main type of business is original equipment manufacturing (OEM) and original design manufacturing (ODM). An OEM/ODM business is different from an own brand manufacturing (OBM) business in many aspects. With OBM, companies can entirely control their marketing activities. In the case of OEM/ODM, on the other hand, firms are not involved in their OEM/ODM customers’ sales/marketing activities. Companies isolated from the customer base, still need to satisfy customer needs and to react to all the customer changes immediately. They are compelled to closely cooperate with all of the members on the supply chain so as to be able to react to any unexpected changes. To cope with the rapid changes in customer needs and the extremely short product life cycles, the cross-functional cooperation of information systems in the IT industry may be more important than those industries with a longer product life cycle. These two unique features – the rapid customer changes and short product life cycles – of the IT industry indeed encourage the companies to improve SCM competences and performance. There is much academic research and there are many empirical studies that show that firms with superior supply chain management competence have better performance (Byrd & Davidson, 2003; Closs & Mollenkopf, 2004; Gunasekaran, Patel, & McGaughey, 2004; Narasimhan & Kim, 2002); but how can ERP be expected to support or create firm competences in SCM? Are there any limitations to or weaknesses of the impact of SCM while companies are under going ERP implementation? The evidence that the Taiwanese IT industry has had a highly suc-

cessful growth experience with SCM competences shows that it can be documented, and lessons can be learned.

This article sets the stage for recently completed research concentrating on SCM and ERP issues. First, definitions of those terms are provided, and compared with recent usage. Second, a review of past research on ERP and SCM is presented to illustrate the ERP benefits and supply chain competences. A conceptual research model is proposed. Third, data collected from Taiwanese IT firms through a survey and interviewing of experts is presented. The respondents to the survey were, primarily, chief information officers or IT industry related engineers or users and other top IT executives. And fourth, the confirmation of the overall proposed model is important because it provides empirical evidence that ERP impact on the supply chain did lead to better overall SCM competences. The results confirm that ERP provides benefits in the following areas lead to significant improvement in the firm competences of SCM: (1) operational benefits, relating to cost reduction, cycle time reduction, productivity improvement, quality improvement, and customer service improvement; (2) business process and management benefits, relating to better resource management, improved decision making and planning, and performance improvement; and (3) strategic IT planning benefits, involving building business flexibility, IT cost reduction, and increased IT infrastructure capability.

2. Literature review

2.1. Supply chain management and firm competences

Supply chain management (SCM) is a 21st century paradigm of IT infrastructure. It focuses on globalization and information management tools that integrate procurement, operations, and logistics from raw materials to customer satisfaction (Kovacs & Paganelli, 2003). Further, it increases manufacturing flexibility, transportation speed, and information availability, as well as management complexity. In recognition of these challenges, practicing managers and academic researchers have realized that SCM has been a major component of competitive strategy to enhance organizational productivity and profitability.

Not everyone, however, means the same thing by the term “supply chain.” Generally, it has three levels. Some have restricted its meaning to apply to only the “relational” activities between a buyer and seller (Ellram, 1991). A second use of “supply chain” takes a broader view by including all “upstream” suppliers to a firm (Dobler & Burt, 1996). Yet a third view takes a “value chain” approach, in which all activities required to bring a product to the marketplace are considered part of the supply chain (Lee & Billington, 1993). Manufacturing and distribution functions are thus included as part of the flow of goods and services in the chain.

The definition of supply chain used in the present research follows the spirit of the value chain concept. The supply chain is the network of facilities and activities that performs the functions of product development, procurement of material from vendors, the movement of materials between facilities, the manufacturing of products, the distribution of finished goods to customers, and after-market support for sustainability. Such a holistic approach is consistent with the integrated way today’s global business managers are planning and controlling the flow of goods and services to the market place.

The literature on SCM that deals with strategies and technologies for effectively managing a supply chain is quite vast. In recent years, the competences and performance of SCM have received much attention from researchers and practitioners. The relationship between firm competences and the impact on the performance of enterprise and supply chains has been remarkably

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