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Improving the global supply chain through service engineering: A services science, management, and engineering-based framework

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ABSTRACT

Great changes within the business environment in the last 2 decades have made supply chain management (SCM) an important topic for academics and practitioners. Globalization, larger reliance on layered suppliers for specialized capabilities and innovation, changing customer needs, reliance on supply networks to maintain a competitive advantage, and developments in technology have all contributed to a very different supply chain environment. Most current works view customers as being outside the supply chain design; however, we believe that customers are the missing link in the supply chain. Therefore, in this paper, we focus on the customer's role in the process. We present an original discussion of the emerging discipline of services science, management, and engineering (SSME) in SCM, identify and bridge the gaps between SSME and SCM, as well as discuss ways to align them. In addition, we consider the specific challenges as well as the opportunities for SSME in supply chain management.

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1. Introduction

The global supply chain facilitates functions such as purchasing, operations, manufacturing, and logistics. It plays a key role in supplying goods and services to final customers (Narasimhan & Talluri, 2009). Traditionally, interest in global supply chains has focused on operational issues, such as manufacturing and efficiency (Kuei, Madu, Lin, & Chow, 2002; Lin, Chow, Madu, Kuei, & Yu, 2005). However, since its foundation in the manufacturing industry in the 19th century, supply chain management has undergone substantial changes. In today's highly competitive global economy, changes in customer requirements, the business environment, and supply networks, as well as shortened product cycles, have together changed the competitive environment of supply chains. There is now a greater need for rapid responses to meet customers' demands for more high quality products and services (Lin et al., 2005). Clearly, the keen competitive environment of the

21st century requires supply chain management (SCM) to be more proactive than in the past.

Because of the continuing transformation of industrialized economies from a manufacturing base to a service orientation, the global supply chain, which is characterized by multilayered supplier-customer relationships, presents a number of opportunities and challenges (Demirkan et al., 2008; Smith, Karwan, & Markland, 2007; Spohrer & Maglio, 2008). Numerous studies have shown that high levels of quality and service are essential if suppliers wish to meet supply chain challenges and enhance their competitive position in today's global environment (Abdullah & Tarib, 2012; Bendoly, Donohue, & Schultz, 2006; Chua & Linb, 2011; Doukidis, Pramatar, & Lekakos, 2008; Lin et al., 2005; Roussinov & Chau, 2008; Singhal, Singhal, & Starr, 2007). However, some scholars argue that the importance of services has been underemphasized (Metters & Maruchek, 2007). Therefore, companies in the supply chain must understand the needs of service stakeholders in order to identify problems and opportunities (Li, Wang, Yu, & Yang, 2007).

In recent years, an interdisciplinary field called services science, management, and engineering (SSME) has emerged to coordinate the design and implementation of services systems. The rationale behind SSME is that service is a complex system that requires organizing people and technologies to perform tasks that provide

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value for others. The objective is to combine fundamental scientific and engineering theories, models, and applications with facets of the management field (Dietrich, Paleologo, & Wynter, 2008; Li et al., 2007). Most importantly, SSME stresses the critical importance of customers, and emphasizes the balance between technology and the fulfillment of customers' needs. It provides a framework for organizations to rethink their service design philosophy and reexamine the enabling process in a scientific manner.

SSME is a new discipline, so academics and practitioners in the SSME community are still laying the groundwork for this challenging research area (IBM, 2009). Researchers argue that there is an urgent need to: (1) explore the use of SSME in the supply chain; (2) consider the service dimension of complex, global, and emerging supply chains, and increasingly service-orientated enterprises; and (3) facilitate and enhance service innovation (Johnston, 2005; Neely, 2007; Paton & McLaughlin, 2008; Roth & Menor, 2003; Voss, Roth, & Chase, 2008). Hence, researchers are keen to identify the frameworks and theoretical perspectives most appropriate for studying service-oriented management issues (Demirkan et al., 2008; Maglio & Spohrer, 2008; Spohrer & Maglio, 2008). However, relatively few studies have focused on ways to bridge the gap between SSME and SCM.

Given this background and our belief that customers are a fundamental part of the supply chain, we consider the following research questions in this study: (1) What can SSME contribute to the global supply chain, and what are the gaps between SSME and SCM? (2) What are new conceptual frameworks and theoretical perspectives appropriate for studying service-oriented technologies and management practices?

In the remainder of this paper, we provide a survey of SSME, and express our views about the field and its development. In particular, we discuss the relevance of SSME to SCM, and examine opportunities to emphasize the concept in supply chain management. We also identify opportunities to make SSME help SCM. Finally, we present an SSME-based supply chain framework that pinpoints how to use SSME to SCM. Our goal is to foster a better understanding of how best to encourage service innovation in an increasingly complex business environment.

2. Previous work

2.1. The service background

Service innovation is a critical driver for business growth, and has gained much attention in the last decade (Paton & McLaughlin, 2008; Paulson, 2006). The majority of workforce is engaged in service providing rather than in agricultural or manufacturing activities in modern world. Research also provides evidence that many of the major manufacturing companies generate a growing portion of their revenues from service activities. Bryson et al. (2004) argued that the demand for services as an input to the production of goods has been growing enormously in the past decades. Given that background, Chase and Apte (2007) pointed out that researchers and practitioners have been aware of the importance of services in the supply chain with the continuing growth of the service sector. Weng, Su, and Lai (2011) also argued that service is indispensable part of business success, while Lien, Wen, and Wu (2011) emphasized the critical role of service quality for process.

Service innovations have the potential to influence service productivity, service quality, and the rates of growth and return of service systems (Spohrer & Maglio, 2008). As a result, most large manufacturing companies have now recognized the importance of service and adopted service-oriented business strategies accordingly. For example, a shift from service orientation to the focus of

product-orientation of their business strategies by leading global corporations, such as IBM, HP, and EDS, have been observed (Li et al., 2007). Moreover, top management of IBM transformed itself as a service business because of realizations that the company must achieve effective service innovations (Demirkan et al., 2008). Since 2004, the company has expended efforts on incorporating service concepts into its business model, and thereby redefined its business strategy. IBM's key service concepts are to improve quality, sustainability, learning from customers, and innovation (Li et al., 2007; Zhao, Tanniru, & Zhang, 2007).

2.2. SSME

SSME developed from the pioneering work of researchers at IBM and associated institutions (Allen, Mugge, & Wolff, 2006; Chesbrough, Vanhaverbeke, & West, 2006; Maglio & Spohrer, 2008). Specifically, SSME highlights the importance of service, and tries to harness the power of scientific and engineering theories, models and applications to support service design as an industrial product. This enhances service innovation and user satisfaction (Bitner & Brown, 2008), and motivates both practitioners and academics to nurture the adoption of SSME (IBM, 2009).

Spohrer and Maglio (2008) emphasized that service can create value and supported by many studies (Demirkan et al., 2008; Lusch, Vargo, & Wessels, 2008; Sampson & Froehle, 2006; Vargo & Lusch, 2004). To date, the majority of SSME studies have focused on system development.

Studies of services have been applied on marketing, management or service sector economics (Demirkan et al., 2008). For example, the call center operations (Chevalier & Van den Schrieck, 2008), the financial services industry (Menor & Roth, 2007; Nair & Anderson, 2008), and the health care industry (Cayirli, Veral, & Rosen, 2008; Van Dijk & van der Sluis, 2008). Li et al. (2007) observed that there are still few studies in SSME because SSME is a relatively new area. Many studies focus on an overview of the field and are not directly relevant to SSME. A business-technology perspective, which induces more synthesis, is greatly needed; despite this, earlier studies only discussed service from a business perspective (Li et al., 2007).

Our survey of previous works identified several trends in existing SSME studies. First, service innovation and technology issues should be both valued, in contrast to merely focusing on the technological aspect for the new discipline (Abe, 2005). Second, service-oriented architectures must be emphasized as this issue has been emphasized by many studies (Bitner & Brown, 2008; Chesbrough et al., 2006; Demirkan et al., 2008; Janner, Schroth, & Schmid, 2008; Lusch et al., 2008; Spohrer & Maglio, 2008; Vargo & Lusch, 2004; Zhao et al., 2007).

2.3. The need for an SSME framework

SSME requires interdisciplinary research to enhance its applications while the attention from multiple disciplines acting independently is positive (Abe, 2005; Allen et al., 2006; Chesbrough et al., 2006; Paton & McLaughlin, 2008; Paulson, 2006). There is also a great need to study SSME from a business operation perspective (Demirkan et al., 2008; Goo, Kishore, Rao, & Nam, 2009; Maglio & Spohrer, 2008; Smith et al., 2007).

SSME is in its exploratory phase. Voss et al. (2008) proposed a service framework for the field of operations management. They argued that framework developing is young in this field and to develop a clear concept and framework contribute to the development of SSME (Li et al., 2007). Nevertheless, the literature on the supply chain is quite sparse. Hence, there is a great need for a framework that: (1) includes the unique characteristics of SCM; and

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