Web technology in supply chain: an empirical investigation

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Abstract

Purpose – The purpose of this paper is to investigate empirically the critical factors for the diffusion of web technologies in supply chain management (SCM) functions, based on the technology-organizational-environment model, and to identify the benefits resulting from diffusion.

Design/methodology/approach – Data were collected, via an internet survey, from 251 respondents, ranging from middle-level to top-level managers, from firms which currently utilize web technologies for their supply chain activities. Structural equation modelling was employed for five factors: relative advantage; competitive pressure; complexity; trialability; and top management support, which have been hypothesized to affect the diffusion of web technologies in SCM functions.

Findings – The results suggest that all the factors except trialability are significant predictors of web technologies' diffusion in supply chain functions. The results show also that by diffusing web technologies, organizations can enhance their supply chain activities.

Research limitations/implications – The survey was conducted in a Malaysian context, using a limited set of variables, thus limiting the generalizability of the findings.

Practical implications – This study provides a greater understanding of managers' perception of web technology diffusion in their organizational SCM functions, and benefits realizing from diffusion of web technology, such as operational efficiency.

Originality/value – Those interested in adopting web technologies in their supply chain activities may find these results helpful in guiding their efforts.

Keywords Malaysia, Managers, Information technology, Internet, Diffusion, Web technology, Supply chain management

Paper type Research paper

Introduction

The potential of web technologies to transform business models, organizational structures and the process of an inter-firm relationship with customers, suppliers and other business partners is now universally accepted by many popular organizations (Asare *et al.*, 2011; Chatterjee *et al.*, 2002; Pinho *et al.*, 2011; Zheng, 2011). Owing to their immense potential, web technologies have become an integral part of business activities for many *Fortune 500* companies. Eventually, this advancement in technologies will provide new platforms

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for the companies to extend their business activities (Ranganathan *et al.*, 2004). Many firms, such as Dell, Wal-Mart and Intel, have acknowledged that they enhance their supply chain functions by using web technologies. They have also stated that after implementing web technologies they can provide superior value to their customers, which helps them to acquire competitive advantage (Lancioni *et al.*, 2000; Pinho *et al.*, 2011; Talib *et al.*, 2010; Tarofder *et al.*, 2010).

Supply chain management (SCM) consists of different business activities, ranging from the purchasing of raw materials to vendor management. The primary focus points of the supply chain management functions are minimizing cost, improving service, increasing interaction among business partners, and providing flexibility in most of the supply chain activities, especially delivery and response systems. Web technologies offer ample opportunities for the organizations by ensuring efficiency in operations, providing electronic payment systems, making communication easier and frequent among business partners, fulfilling the order, facilitating inventory management, and improving their supply chain performance. Therefore, to be competitive in the current business world, many companies (Wal-Mart, Retail Link, Transsora.com, Vertical.Net) are using web technologies in their supply chain management functions. Hence, there are no questions of the importance of web technologies in SCM. However, it is still unclear the main difference between internet and web technologies among the parishioners. Theoretically, both internet and web technologies are merely same. But based on the technical aspects, there is fundamental difference between these two technologies. Internet is a structure of delivering web technologies. More specifically, web technologies are combination of advance contents which facilitates collaborative business environment. In addition, with the help of web technologies, organizations are able to coordinate and integrate their business activities more effectively and efficiently.

In view of the capability of web technologies to bring about radical improvement to the performance of many supply chain activities (Benjamin and Elsie, 2003; Chatterjee *et al.*, 2002; Chou *et al.*, 2004; Kim and Galliers, 2004; Russell *et al.*, 2004; Sanders, 2007) and the subsequent performance of organizations, SCM has become a priority item on top executive agendas, in their search for competitive advantage. They realize that web technologies can provide the perfect platform for tighter coordination, which serves as a benchmark for superlative supply chains.

In Malaysia, the IT market is expected to increase from USD 1.2 billion in 2007 to USD 2 billion in 2012, with a compound annual growth rate of 11.1 percent (International Data Corporation – IDC, 2009). IDC also forecasted that spending on business services would grow between 17 and 18 percent in 2009. In addition, Malaysia's IT investment grew between 4 and 5 percent in 2009, surpassing the USD 6 billion mark. In spite of heightened interest and increased investment in IT, it was reported that Malaysian businesses have been relatively slow in web adoption (Alam and Ahsan, 2007; Tan, 2006). Only 30 percent of Malaysian enterprises have a web presence and use IT in their daily operations (Liu *et al.*, 2010). This reflects a poor rate of IT utilization among the estimated 600,000 local enterprises. Most Malaysian enterprises perceive cost, risk, complexity, and lack of technical personnel as the main barriers to IT and/or e-commerce implementation (Chong *et al.*, 2008; Kogilah *et al.*, 2008; Pires and Aisbett, 2001; Yeung *et al.*, 2003) even though the country has sufficient infrastructure and technological facilities (Husnayati and Rafidah, 2005; Intan *et al.*, 2008).

Many benefits of web technologies in SCM functions have been identified by organizations, however, the implementation of web technologies and system is challenging (Chong and Ooi, 2008; Ranganathan *et al.*, 2004; Tarofder *et al.*, 2010). For the successful diffusion of web technologies, organizations require a combination of several critical factors, such as organizational characteristics, technological attributes, environmental factors and so on (Ranganathan *et al.*, 2004; Tarofder *et al.*, 2010). The success of web technologies' diffusion in SCM depends greatly on which system or application is used by organizations and their partners in the supply chain. Based on this challenge, many important questions remain. For example, is there any difference between manufacturers and service providers in the diffusion factors of web technologies? Is there any difference between innovators and other group of adopters in the diffusion factors of web technologies? How do companies implement web technologies effectively in their supply chain management? What are the critical factors influencing the effective adoption of web technologies? What types of management practices are important for the successful diffusion of web technologies in the supply chain?

Therefore, the focal point of the present study is to gain in-depth knowledge of the effective diffusion of web technologies in SCM functions. More precisely, the objectives of this study are to identify empirically the important determinants influencing the effective diffusion of web technologies in SCM, and to assess the perceived benefits resulting from this effective diffusion.

There is a considerable amount of research in the area of diffusion of innovation in different contexts, such as IT (Bakker *et al.*, 2008; Croom, 2005); electronic data interchange (EDI) (Chau and Hui, 2001; Seyal *et al.*, 2007); and enterprise resources planning (ERP) (Li, 2011; Upadhyay *et al.*, 2011). In contrast, very little research has been conducted empirically to examine the diffusion of web technologies and their benefits (Ranganathan *et al.*, 2004; Tarofder *et al.*, 2010). There is a fundamental difference between web technologies and traditional EDI systems, especially in the supply chain context. Supply chain management can reach beyond the boundaries of a single company, to share information among suppliers, manufacturers, distributors and retailers. And web technologies play an important role by providing a collaborative platform for all the business partners, including customers (Graham and Hardaker, 2000).

For example, General Electric (GE) in the USA is a first mover who realized the benefits of shifting from a physical to an electronic business community model. The trading process network (TNP) of GE is an online business community that transacts about USD 1 billion worth of business, with more than 1,400 suppliers scattered around the globe (Graham and Hardaker, 2000). Therefore, it is important to examine and identify the factors that facilitate the diffusion of web technologies in SCM functions (Tarofder *et al.*, 2010).

Similarly, there is a lack of literature about information systems (IS) related to web technologies' diffusion in SCM functions (Sanders, 2007). Moreover, this is hardly found in the Malaysian context. Hence, this study tries to fill this gap by identifying critical determinants for the effective diffusion of web technologies, and provide empirical evidence of the benefits acquired from this diffusion, in the Malaysian organizational context.

Literature review

In the last few decades researchers have paid great attention to IT diffusion in organizations (Doolin and Ali, 2008). This study focuses mainly on primary diffusion rather than secondary. Primary diffusion focuses mainly on diffusion of innovation by an organization, whereas secondary refers to diffusion by individuals within the organization. In this study, organizational diffusion has been considered as a process which started with initial awareness and evaluation of a new technologies or services, followed by a decision to purchase and implement the innovation, and finally to spread it out among partners of the organization (Bakker *et al.*, 2008; Chan and Ngai, 2007; Ranganathan *et al.*, 2004; To and Ngai, 2006; Tarofder *et al.*, 2010).

Many researchers have tried to develop various theoretical concepts for IT adoption by organizations. The notion of extended enterprise, one of the popular theoretical frameworks for supply chain management, was developed by Chan (2004). This concept was developed for the supply chain management approach, by integrating all business partners in one single network to achieve a common objective. The fundamental aim of this concept is to yield new value by integrating all business activities into one value network (Stabell and Fjeldstad, 1998). Chan (2004) described this model based on three important views; namely, external, conceptual and internal views. He considered external views as user application, operational and analytical processes, and organizational structures. The conceptual view consists of a conceptual data function model supporting operational and analytical requirements. And lastly, internal views consist of the technical implementation of data storage, software modules, hardware platforms and telecommunication networks. Eventually, all these layers can be connected through the construction of the enterprise information roadmap, to provide extra value to all the organizational partners (Chan, 2005). Hence, the Internet together with traditional IT has had a significant impact on SCM systems. Many industries, airlines, hospitals, and so on, have acknowledged the significant improvements resulting from IT enabled inter-organizational systems during the 1980s and 1990s (Johnston and Vitale, 1988). Therefore, it is clear to all organizations that Information Technologies play a very important role in adding value to the SCM. In this regard, many renowned organizations across the world have invested significant amounts in developing web technologies in their supply chain, as these technologies offer great enhancement of business activities (Ranganathan *et al.*, 2004; Tarofder *et al.*, 2010).

To identify the determinants of the diffusion of web technologies, various researchers have utilized a number of approaches (Doolin and Ali, 2008). One common approach is to identify a set of contingency factors that explain collectively the innovation diffusion (Fichman, 2004; Jeyaraj *et al.*, 2006). Other researchers have employed "technologies-organizational-environment" model which encompasses factors of IT innovation adoption. This model was first developed by DePietro *et al.* (1990). A number of empirical studies have acknowledged the usefulness of this model, and it has been extended to other innovation domains such as this study (Doolin and Ali, 2008; Zhu *et al.*, 2003).

This technologies-organizational-environment model proposes that organizational innovation adoption is influenced by three important factors, namely:

(1) perceived characteristics of the new innovation;

(2) organizational characteristics; and

(3) environmental condition.

Owing to difficulties in examining all the proposed factors belonging to each group, prior studies of innovation adoption have identified a complex and rich group of potentially relevant factors within each of these three elements (Russell *et al.*, 2004). Figure 1 shows the adoption model for this study.

Characteristics of new technologies

From their vigorous analysis of diffusion studies, Jeyaraj *et al.* (2006) found relative advantages, complexity and compatibility as the most utilized independent technological characteristics for IT adoption among organizations. In this research, perceived usefulness is considered as an important technologies attribute instead of relative advantages. Perceived usefulness was identified by Davis *et al.* (1986), in their technologies acceptance model, which is another popular theory among diffusion researchers. Finally, this research motivated by diffusion of innovation theory developed by Rogers (1962). He defined innovation as "an idea, practices or object that is perceived as knew by an individual or other unit of adoption". Based on this definition, web technologies consider as an innovation and organizations considered as unit of adoption. This theory provides a strong theoretical background for the diffusion process. More specifically, this theory helps to identify the important determinants for diffusion of an innovation. There are three different diffusion models that are highly popular among diffusion researchers which are developed based on fundamental structure of diffusion theory. Apart from the analytical economic research approach, number empirical studies have used Rogers's diffusion theory of as a basis for their research (Jeyaraj *et al.*, 2006). In addition, Rogers identified five innovation characteristics as important determinants for diffusion of innovation. However, all determinants are not important for web technologies as these technologies become an important component for business activities. Jeyaraj *et al.* (2006) mentioned relative advantages, complexity and trialability are the most influential factors for diffusion of Internet. In addition, relative advantage and perceived usefulness use interchangeable in many recent researches. It is because technology acceptance model was developed based on this theory. Therefore, this study does not consider perceived usefulness as an important determinant for web technologies. Moreover, this research considers trialability instead of compatibility as a strong influencing factor for the diffusion of web technologies. This is because this study assumes that organizations always try to maximize the value of using new technologies. Therefore, organizations prefer to try before taking final decisions about using new technologies. Hence, trialability

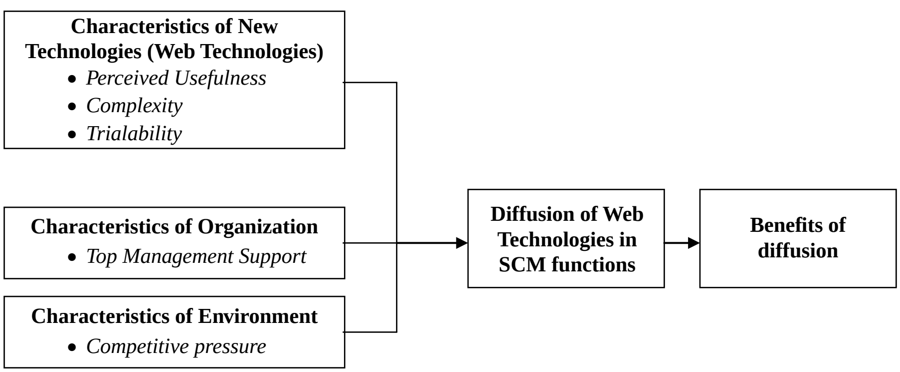

Figure 1. Conceptual model for the diffusion of web technologies in supply chain management functions

is an important determinant of the diffusion process. The next section discusses of all these factors in more detail.

Perceived usefulness

Perceived usefulness refers to the benefits in terms of efficiency arising from the use of new technologies (Chan and Ngai, 2007; Mpofu and Watkins-Mathys, 2011). It is well accepted by many researchers that web technologies have been advocated as a significant route for the development of operations and strategic supply chain management in many organizations (Croom, 2005), and continuously provide important new avenues for wealth creation (Amit and Zott, 2001). Numerous recent studies (Ahuja and Thatcher, 2005; Dow *et al.*, 2008; Gallivan *et al.*, 2005; Ifinedo, 2011; Liao *et al.*, 2011; Shih *et al.*, 2008; Tarofder *et al.*, 2010) have done research in the context of the diffusion of innovation within organizations, by developing models of various determinants and measures of IT diffusion. Eventually, all these studies confirmed the positive relationship of the perceived usefulness of the diffusion of information technologies within organizations. Based on this discussion, this study proposed the first hypothesis as:

H1. There is a positive significant effect of perceived usefulness on the rate of diffusion of web technologies in supply chain activities.

Trialability

Trialability is an innovation attribute which is drawn from the Rogers' (1983) Model of Diffusion of Innovation. In Rogers' adoption model, trial is the fourth step before final adoption. This indicates that triabability is related to the perceived risk of using new technologies and is likely to reduce the uncertainty of diffusion of new innovation or technologies. Finally, trialability assists adopters to evaluate the benefits of having that innovation or technologies, which makes it easy for adopters to take the decision.

Many of the earlier studies (Alam *et al.*, 2007; Doolin and Troshani, 2007; Oh *et al.*, 2003) have considered this important factor for innovation diffusion in different technological contexts, such as extensible markup language (XML), E-commerce, etc. Therefore, this study also considers trialability as an important determinant for the diffusion of web technologies in SCM functions and develops the second hypothesis for this study as stated below:

H2. There is a significant positive effect of trialability on the rate of diffusion of web technologies in supply chain activities.

Complexity

Most diffusion models have supported complexity as an important factor for the diffusion of technologies. Complexity refers to the degree to which a new technologies is comparatively difficult to apply and understand (Rogers, 1962). In particular, organizations are more reluctant to adopt a new technologies when it is difficult to use and understand (CHiasson and Lovato, 2001). More studies have considered this important factor for innovation diffusion in different technological contexts, such as XML, eXtensible business reporting language (XBRL), EDI, ERP, E-business, etc. and most researchers identified negative effects of complexity on the adoption of technologies. Above discussions lead to develop the third hypothesis for this study as stated below:

H3. There is a significant negative effect of complexity on the rate of diffusion of web technologies in supply chain activities.

Environmental factors

To be more efficient in supply chain management functions, environmental factors could be important determinants for the diffusion of technologies. Larger manufacturing organizations always put pressure on their trading partners so that they will meet world standards, which is very important in the globalization arena. Hence, the diffusion of web technologies in SCM functions could be a result of pressure exerted by different actors within the industry. It has been suggested that firms experiencing intense competition will have a faster rate of diffusion of technologies within the organization (Ifinedo, 2011; Teo *et al.*, 2003; To and Ngai, 2006; Warrts *et al.*, 2002).

In this century, responsiveness is one of the important strategies at all levels of the organization. Organizations can lose many opportunities without having this responsive strategy. Therefore, it is clear that competitors nowadays tend to be more responsive and careful about competitors' actions, especially in the global environment. Julien and Raymond (1994) have also identified that the status of a business, expressed in terms of independence from or affiliation to a group or network of firms, is significant in the adoption of technologies. Hence, in order to be part of large group, a company does not have any other choice except to adopt the technologies. Similarly, other researchers also found significant effects of external pressure on diffusion process. Examples include pressure from trading partners (Iacovou *et al.*, 1995); readiness of business partners (Zhu *et al.*, 2003); partners' influence (Doolin and Ali, 2008; Ifinedo, 2011); competition in industry (Raymond and Uwizeyemungu, 2007); and competitive pressure (To and Ngai, 2006).

In addition, firms that are pioneers in deploying IS tend to have a more competitive advantage. Hence, there is significant pressure for organizations to diffuse the system quickly in order to gain a competitive advantage (Ranganathan *et al.*, 2004). Therefore, organizations facing higher competitive pressure are likely to expend considerable effort in diffusing web technologies to partners, so as to strengthen the integration with business partners that could give them a competitive advantage. This leads to the following hypothesis:

H4. There is a positive significant effect of competitive pressure on the rate of diffusion of web technologies in SCM functions

Organizational characteristics

IS introduction can be considered as the diffusion of technologies in a social system. Therefore, the alignment between organizational and technological need is very important to be successful in diffusion process. As a result, organizational characteristics play an important role in the diffusion of technologies. In fact, prior research considers this is as one of the most critical factors for the diffusion of technologies (Doolin and Ali, 2008; Li, 2011; Raymond and Uwizeyemungu, 2007).

This factor can be defined by different characteristics of the organization, such as its employees, available internal resources, profit, and so on. Different studies found a significant effect of the size of organization on diffusion process (Bernroider and Koch, 2001; Grover and Goslar, 1993). Grover and Gosler identified the that size of the organization had a significant and positive effect on the adoption of IT within the organization, and concluded that the larger the organization, the greater the resources for adoption and implementation of new technologies. Similarly, Bernroider and Koch found a significant difference between medium-sized enterprise and larger enterprises, in terms of the selection and implementation of new technologies.

Among these varied characteristics, support from top management is one of the most influential factors for the diffusion of technologies (Jeyaraj *et al.*, 2006). More specifically, the commitment, involvement and support of top management can give the right direction which matches organizational goals, as they ensure adequate resources and communicate the significance of the diffusion, leading eventually, to an increase in the diffusion rate (Ifinedo, 2011; Mosbeh and Soliman, 2008; Russell *et al.*, 2004; Sohail and Teo, 2003; Upadhyay *et al.*, 2011). Therefore, this study considers top management support as an important factor for the diffusion of web technologies, and develops the following hypothesis:

H5. There is a significant positive effect of top management support on the rate of diffusion of web technologies in SCM functions.

Benefits of web technologies' diffusion in SCM

It has been well acknowledged that IT has a positive effect on business activities, especially on operational activities. A number of researchers have examined the effect of e-business technologies on the supply chain (Dong *et al.*, 2010; Lin, 2008; Ranganathan *et al.*, 2004; Sanders, 2007; Wiengarten *et al.*, 2011). Similarly, other researchers have assessed the benefits of the diffusion of IT at national, industry and firm levels (Barua and Mukhopadhyay, 2000; Dehning and Richardson, 2002; Kohli and Devaraj, 2003; Mahmood and Szewczak, 1999). Recent studies have shown a mixed view about the benefits of the diffusion of web technologies in the context of the supply chain. For example, Devaraj *et al.* (2007) investigated the effect of e-business technologies on the operational benefits, but did not identify any significant direct benefits on operations except the betterment of customer service and supplier integration. Similarly, Power *et al.* (2010), in a more recent study, investigated the effect of the electronic market place on operational benefits, but based on their analysis, they concluded that the electronic market place was not very effective in terms of operational performance unless all business partners had integrated themselves into the same network.

In another study, Sanders (2007) examined the effect of e-business technologies on operational and strategic points of view. He identified that e-business technologies had a positive effect on both. Similarly, Ranganathan *et al.* (2004) examined the benefits of the assimilation and diffusion of web technologies in the supply chain. Their results showed that benefits, such as customer service, inventory control, operation cost, cycle time, and relationships with suppliers, can be enhanced by the assimilation and diffusion of web technologies. Moreover, studies related to ERP and EDI have shown positive effects on the business performance. For example, Lee *et al.* (2006) identified a significant positive improvement in business performance by adopting an EDI enabled supply chain in the retail industry. Chatfield and Yetton (2000) concluded that organizations can gain strategic benefits from the adoption of EDI. Rajendran *et al.* (2008) identified that by adopting information systems in small businesses can improve their business performance in terms of sales growth, profitability, financial resources and public image. Moreover, theoretically, operations management also indicates that web systems have a significant impact on the SCM functions (Lancioni *et al.*, 2000). Finally, Lee and Whang (2001) identified many benefits related to the electronic supply chain, focusing mainly on cost, speed and communication. They also mentioned that the electronic supply chain can provide a time platform for information sharing. At the very least, e-SCM has the ability to provide early warning signals when products are running out. Consequently, organizations can manage their inventory effectively. Hence, it is important to adopt technologies in SCM to manage efficiently and effectively. However, the researchers mentioned that e-business technologies are not adequate on their own to provide competitive advantage. This requires additional resources such as IT, human resources, infrastructure (Melville *et al.*, 2004; Power *et al.*, 2010; Wade and Hull, 2004). Moreover, Wiengarten *et al.* (2011) mentioned that the benefits of adoption or diffusion of technologies in supply chain management are still not fully understood. Therefore, based on the above discussions, this study proposes the following hypothesis:

H6. There is a positive impact of the diffusion of web technologies on the benefits of the diffusion of web technologies in SCM.

Research methods

On the basis of research objectives, this research used both descriptive and causal research. Descriptive research for this study helps to explain the characteristics of web technologies, and determines the frequency of the occurrence of this important phenomenon, such as SCM practice by the organizations using web technologies for their operations. Despite this, descriptive analysis cannot explain any relationship between dependent and independent variables. Hence, this research also adopted causal research. As a result, the research can test both hypotheses and associations between dependent and independent variables.

Development of research instrument

The only instrument used in this study is a structured questionnaire. This study used a structured questionnaire for two reasons:

(1) questionnaire provides standard responses from respondents compared to interviews (Sekaran and Bougie, 2010); and

(2) all important information can be collected in a structured form compared to other instruments (Hair *et al.*, 2008).

Questionnaire development for this study started by identifying appropriate data to provide the right answers to the research questions. Hence, this research clearly defined both conceptual and operational definitions of all the variables identified in the literature review. Table I provides definitions for all the variables. All the variables were measured using a five-point Likert scale. For example, in this study, questions about "trialability" were "very important" or "not at all important" for the diffusion of web technologies. Moreover, all the variables were measured by four items of questions. Based on scaling procedures used for the questionnaire, close-ended questions were used wherever possible owing to the larger scale survey approach (Sekaran and Bougie, 2010).

Table I.
Conceptual and operational definitions of all variables

Variables	Conceptual definitions	Operational definitions
Perceived usefulness (Mpofu and Watkins-Mathys, 2011; Liao *et al.*, 2011; Ifinedo, 2011; Dow *et al.*, 2008; Chan and Ngai, 2007; Shih *et al.*, 2008; Mosbeh and Soliman, 2008; Nikolaeve, 2006; Afzal *et al.*, 2007)	Perceived usefulness is considered to be "the prospective adopter's subjective probability, that by applying the new technologies from outside sources will be beneficial to the adopting company's well-being"	Perceived usefulness is considered to be the users' perception of the benefits of using web technologies for supply chain functions
Complexity (Lin and Wu, 2004; Money and Turner, 2004; Jaakkola and Renko, 2007; Nabeel, 2007; Doolin and Troshani, 2007; Alam *et al.*, 2008; Migiro, 2006; Mosbeh and Soliman, 2008)	Complexity refers to the difficulties of using new innovation for individuals	Complexity is defined as how difficult it is to use web technologies in the organization
Top management support (Upadhyay *et al.*, 2011; Li, 2011; Ifinedo, 2011; Peansupap and Walker, 2005; Suraya and Mazhatul, 2005; Russell *et al.*, 2004; Jeyaraj *et al.*, 2006; Chou *et al.*, 2004; Mosbeh and Soliman, 2008; Lee *et al.*, 2006; Seyal *et al.*, 2007; Obra-Aguila and Melendez-Padilla, 2006; Lin, 2008)	It can be defined as support from top management regarding training, financing and so on, which will be helpful for the employee to adopt new technologies faster	Extent to which top management is committed with resources to support the innovation
Competitive pressure (Kermar *et al.*, 1991; Ranganathan *et al.*, 2004; Kimberly and Evanisko, 1981; Gatignon and Robertson, 1989; Grover, 1993; Bradford and Florin, 2003; Ramamurthy *et al.*, 1999; Chen and McQueen, 2008; Pan and Jang, 2008; Chan and Ngai, 2007; To and Ngai, 2006; Nikolaeve, 2006)	This is the degree to intensify competition among competitors, to provide superior value by reducing cost	Competitive pressure refers to the degree to which organizations need to be responsive to the competitors' actions, in order to adopt the diffusion of web technologies in their supply chain
Trialability (Oh *et al.*, 2003; Raymond, 2001; Robert and Pick, 2004; Gerrand and Cunningham, 2003; Bradford and Florin, 2003; Russell *et al.*, 2004)	Trialability is defined as "the degree to which an innovation may be experimented with, on a limited basis"	This considers a trial of new technologies before final installation
Diffusion of web technologies in supply chain management (Buonanno *et al.*, 2005; Harrison and Waite, 2005; Peansupap and Walker, 2005; Bradford and Florin, 2003; Suraya and Mazhatul, 2005; Alam *et al.*, 2007; To and Ngai, 2006; Bakker *et al.*, 2008; Chan and Ngai, 2007)	This is considered as technologies which can enable companies to integrate and coordinate with trading partners	This is defined as the extent to which web technologies and applications are used in key internal and external organizational activities, in SCM functions
Benefits obtain from diffusion (Melville *et al.*, 2004; Wade and Hull, 2004; Power *et al.*, 2010)	This is considered as lowering costs and providing superior customer value by integrating business partners into one network	Benefits are defined as doing work efficiently and effectively

This study used two types of scale in order to measure information regarding demographic and variables. These scales were categorical and a five-point Likert scale. Finally, all the items to measure variables were adopted from different literatures in the research context, but for different technologies (Michelino *et al.*, 2008; Mosbeh and Soliman, 2008; Mukhopadhyay and Kekre, 2002; Ranganathan *et al.*, 2004; Subramani, 2003).

Sampling

In this research, the population comprised all top management professionals, especially from the organizations using web technologies, such as Proton, Petronas, Telecom Malaysia. The sampling frame for this study was the business database provided by Federation of Malaysian Manufacturers (FMM), Malaysian Investment Development Authority (MIDA), Standard Assessment Procedures (SAP), Exporters and Importers and Port Klang shipping Agencies Associations. All these databases are very popular among Malaysian researchers (Chong and Ooi, 2008).

A stratified random sampling method was used to identify firms which have been using web technologies for their business activities. Out of 2,575 organizations, 1,000 organizations fulfilled the requirements. To decide the sample size, the minimum requirements for structural equation modelling (SEM) of the data were considered. A sample size of 200 satisfies the SEM data analysis (Arbuckle and Wothke, 1999; Hair *et al.*, 1998; Nunally and Berstein, 1994; Schmacker and Lomax, 1996). In addition, the sample size for SEM is affected by many factors, such as the complicated mode, number of latent variables, and number of items used to measure latent variables. However, Kline (2005) suggested that conducting SEM with more than 200 respondents is more appropriate. The total number of respondents for this study was 251 and, therefore, adequate for the complexity of the model and number of latent variables.

In order to overcome the issue of response bias (Armstrong and Overton, 1977; Kanuk and Berenson, 1975; Ranganathan *et al.*, 2004), the non-response bias was examined between early and late respondents on all research constructs. Based on the results of independent sample *t*-test, there is no significant difference between these two groups at a 95 percent confidence interval. In addition, this research also examined bias based on significant correlation between item score and survey response time, and the correlation results revealed that none was significant.

Data collection method

Every survey method has merits and demerits. There is no single best survey method for all research situations (Malhotra, 1999; Sekaran and Bougie, 2010). Therefore, the appropriateness of the survey method depends mainly on the research objectives and research limitations. In selecting survey methods for this research, factors such as time constraint, cost, and the attributes of respondents were taken into consideration (Ranchhod and Zhou, 2001). After considering all those criteria, this study selected an online survey for this study.

Respondents' attributes

Table II presents the demographic profile of the respondents' firm. The sample had a different representation in terms of industry category, which was distributed fairly across different industry groups in manufacturing and service industries. The responding firms reported a broad range of annual revenue, with most of them generating between

Industry	Frequency	%	Annual revenue	Frequency	%
Hotel/travel/tourism	32	12.7	1-5 million	120	47.8
Computer/IT	29	11.6	5-10 million	55	21.9
Business service	27	10.8	<1 million	46	18.3
Transportation/logistics	24	9.6	10-50 million	24	9.6
Engineering	22	8.8	more than 50 million	6	2.4
Finance/banking/insurance	14	5.6	*Respondents' positions*		
Real estate/property	14	5.6	CIO/CTO/vice president for IS/senior vice president for IS	23	9.2
Others	14	5.6	Senior director/director for IS	76	30.3
Retailing/wholesale/trading	13	5.2	General manager/manager/assistant director	54	21.5
Oil/gas	10	4.0	Operation and production manager	54	21.5
Consumer durables	9	3.6	E-business manager	13	5.2
Medical/HEALTH CARE	8	3.2	Project manager	13	5.2
Telecommunication	8	3.2	Other	18	7.2
Textiles/apparel	8	3.2	*Using web technologies for SCM*		
Chemicals	7	2.8	Less than 1 year	76	30.3
Automotive	7	2.8	1 year	85	33.9
Publishing/information	5	2.0	2 years	48	19.1
			3 years	21	8.4
			4 years	18	7.2
			5 years	1	0.4
			More than 5 years	2	0.8

Table II.
Demographic profile

RM 1 million to RM 5 million, followed by between RM 5 and RM 10 million. Only 2.4 percent of them generated more than RM 50 million. Slightly more than half of the respondents were senior level managers, and the majority of them reported that their firm had been using web technologies for less than or equal to one year for their business activities. All the respondents' firms already used web technologies in their SCM functions.

Validity and reliability of measures

Significant precautions were taken during the various stages of development, such as pre-tests and pilot tests of the instrument, to ensure a high degree of content validity. The content validity of the measures was assessed by a pre-test with knowledgeable experts, and construct validity was examined from two key perspectives: unidimensionality and discriminant validity. It was evaluated by exploratory factor analysis (EFA). The three usually accepted decision rules (eigenvalues ≥ 1; factor loading ≥ 0.50 and simplicity of structure) were employed for identification of the factors (Hair *et al.*, 2008). The results of the test for unidimensionality or discriminant validity are reported in Table III. The results of the factor analysis were satisfactory, and all the items measuring seven variables loaded on the appropriate variables. Seven factors emerged as expected. The overall variance was satisfactory for all seven variables. The factor loading was quite satisfactory, ranging from 0.739 to 0.902.

		Factor loading	Percentage of variance
Perceived usefulness	1.761		8.804
Perceived usefulness 1		0.892	
Perceived usefulness 2		0.887	
Perceived usefulness 3		0.886	
Perceived usefulness 4		0.877	
Complexity	8.260		41.300
Complexity 2		0.837	
Complexity 4		0.836	
Complexity 1		0.825	
Complexity 3		0.795	
Trialability	1.445		7.227
Trialability 3		0.828	
Trialability 2		0.792	
Trialability 1		0.769	
Trialability 4		0.739	
Competitive pressure	1.022		5.111
Competitive pressure 4		0.793	
Competitive pressure 2		0.789	
Competitive pressure 1		0.769	
Competitive pressure 3		0.740	
Top management support	3.226		16.130
Top management support 2		0.848	
Top management support 1		0.842	
Top management support 4		0.807	
Top management support 3		0.789	
Diffusion of web technologies	3.152		78.811
Diffusion web technologies 3		0.902	
Diffusion web technologies 1		0.898	
Diffusion web technologies 4		0.883	
Diffusion web technologies 2		0.868	
Benefits realized from diffusion	3.673		80.922
Benefits from diffusion 1		0.867	
Benefits from diffusion 2		0.862	
Benefits from diffusion 3		0.850	
Benefits from diffusion 4		0.819	

Table III.
Results of exploratory factor analysis

Confirmatory factor analysis

This study employed confirmatory factor analysis (CFA) in order to measure the effect of latent variables on the observed variables. CFA also described the measurement properties such as reliability. Moreover, the CFA helps to assess the individual effect on measurement items before testing the final structural model (Anderson and Gerbing, 1988; Hulland *et al.*, 1996). This research also used structural equation model (SEM) to estimate the fit of the hypothesized model to survey data. This study used different types of goodness-of-fit indicators to test both the CFA and the final model, because no single statistical test of significance identifies a correct model from the simple data (Byrne, 2001; Maruyama, 1998). Table IV shows the different goodness-fit-indicators used in this research.

There were two additional criteria used to measure the CFA. First, standardized factor loading shows a strong association between factor and items (Gallagher *et al.*, 2008; Power, 2005; Yeh, 2005) though values greater than 0.50 are sometimes considered

Name	Abbreviation	Type	Acceptable level
Coefficient alpha	α	Unidimensionality	$\alpha > 0.07$ (Power, 2005; Ho, 2008; Yeh, 2005; Hair *et al.*, 2006)
Standardized regression weight	β		
χ^2 (with associated degree of freedom and probability of significant difference)	χ^2 (df, p)	Model fit	$p > 0.05$ (at α equals to 0.05 level) (Norzaidi *et al.*, 2008; Holmes-Smith, 2002)
Root mean square residual	RMR	Absolute fit	RMR < 0.10
Root mean square error of approximation	RMSEA		RMSEA < 0.10 (Lopez and Iglesias, 2010; Norzaidi *et al.*, 2008)
Goodness-of-fit index and adjusted goodness-of-fit index	GFI and AGFI	Absolute fit	Values close to 0.9 and above indicate satisfactory fit (Bigne *et al.*, 2008; Power, 2005; Ho, 2008; Yeh, 2005; Lopez and Iglesias, 2010; Wang, 2010)
Normal fit index	NFI	Incremental fit	Values above 0.8 and close to 0.9 indicate acceptable fit (Bigne *et al.*, 2008; Power, 2005; Ho, 2008; Yeh, 2005; Lopez and Iglesias, 2010; Wang, 2010)
Standardized estimate	Value criteria		
Factor loading	>0.7 good, >0.5 acceptable (Power, 2005; Ho, 2008; Yeh, 2005; Holmes-Smith, 2002; Gallagher *et al.*, 2008)		
Covariance (cr)	>1.96 (Lopez and Iglesias, 2010; Wang, 2010; Gallagher *et al.*, 2008)		

Table IV.
Goodness-of-fit indicators

acceptable (Churchill, 1979). Second, covariance of correlation between two variables is the estimate of the amount, or correlation between two can influence both variables (Schmacker and Lomax, 1996). Therefore, critical ratio (CR) needs to be measured. It is suggested that the CR of the estimate should be greater than 1.96 for the factor loading or variance that it is estimating (Gallagher *et al.*, 2008; Lopez and Iglesias, 2010; Wang, 2010). Table V shows the results of CFA.

CFA was conducted for each of the seven variables with 28 constructs assigned to them. The Cronbach α for all the variables was higher than 0.80. Therefore, data can be considered as highly reliable for this study. Results suggested that only one out of 28 standardized regression weights was less than 0.60. However, all the fit indices of CFA indicated that all the CFA modes were well fitted with the p-value, GFI, AGFI, and NFI. All the values of these indices were at an acceptable level for seven CFA models. Therefore, this CFA analysis is confident to test the final model for this study.

	χ^2	df	P	GFI	AGFI	NFI	RMSEA	RMR	CR	Factor loading	α
Perceived usefulness	3.062	2	0.216	0.994	0.968	0.995	0.046	0.013			0.909
PU1									9.493	0.591	
PU2									9.130	0.794	
PU3									8.349	0.983	
PU4									9.130	0.947	
Complexity	3.179	2	0.204	0.994	0.969	0.996	0.049	0.010			0.926
COM1									8.999	0.895	
COM2									7.592	0.878	
COM3									7.197	0.974	
COM4									8.530	0.891	
Trialability	6.724	2	0.035	0.987	0.937	0.986	0.097	0.020			0.867
TRI1									7.742	0.760	
TRI2									7.187	0.922	
TRI3									8.554	0.933	
TRI4									9.598	0.819	
Competitive pressure	4.238	2	0.120	0.992	0.958	0.994	0.067	0.016			0.913
CP1									8.949	0.970	
CP2									8.381	0.972	
CP3									9.506	0.900	
CP4									8.398	0.949	
Top management support	2.888	2	0.236	0.994	0.972	0.996	0.042	0.010			0.926
TMS1									8.618	0.799	
TMS2									8.949	0.970	
TMS3									7.455	0.957	
TMS4									8.733	0.944	
Diffusion of web technologies	6.513	2	0.039	0.987	0.933	0.990	0.095	0.021			0.910
DWT1									7.569	0.885	
DWT2									7.777	0.953	
DWT3									9.040	0.891	
DWT4									8.510	0.945	
Benefits realized by diffusion	5.549	2	0.062	0.989	0.943	0.989	0.084	0.018			0.879
Benefits 1									8.438	0.878	
Benefits 2									7.145	0.885	
Benefits 3									7.362	0.891	
Benefits 4									7.569	0.837	

Table V.
CFA results for all variables

Hypothesis testing

The conceptual model of this study was examined by using bootstrapping to estimate parameters, standard errors and *t*-value (Hwang, 2004). Figure 2 and Table VI show the results of the hypothesis testing. The conceptual model of this study explained significant variance in the diffusion of web technologies ($R^2 = 0.580$). These fitness indices indicated that data fitted well with the survey data. The overall goodness-of-fit for the conceptual model was acceptable fit (Table VI). The χ^2/df was below 5, with RMSEA and RMR below 0.1. Moreover, NFI and other fit indices were well above the

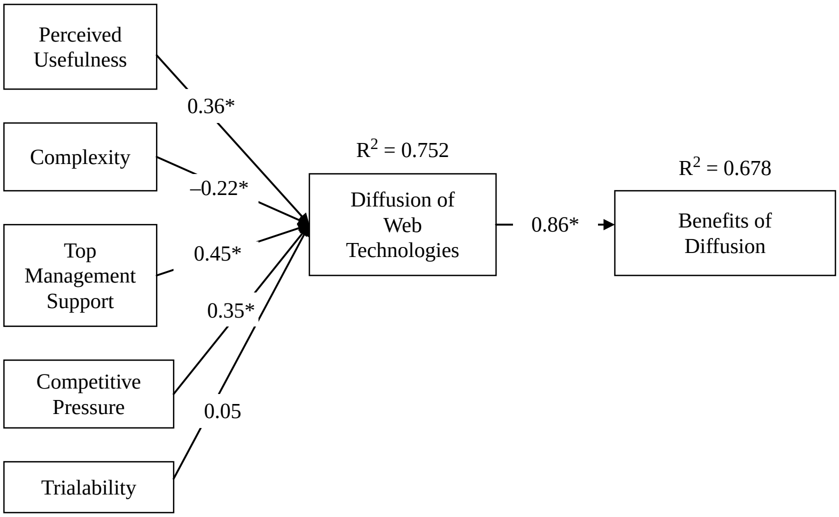

Figure 2.
Hypothesis testing

Table VI.
Results for conceptual model

Fit measures	Main model
χ^2	8.56
Degrees of freedom	7
P	0.29
RMR	0.01
RMSEA	0.03
GFI	0.99
AGFI	0.96
NFI	0.99

desired level, indicating support for the model. In conclusion, these results suggested that the main model can be assessed as being adequate.

All the hypotheses were tested based on the path coefficients with significant value. The model test supports all the hypotheses except *H2*. Supporting *H1*, perceived usefulness had a positive significant effect on the diffusion of web technologies ($\beta = 0.36, p < 0.000$). Similarly, results show that complexity has a significant negative effect on the dependent variable ($\beta = -0.22, p < 0.000$). So *H3* is supported by the test. Supporting *H5*, top management support has a significant positive effect on the diffusion of web technologies, with a coefficient value of 0.45 and significant value less than 0.000. Results related to *H4* show that competitive pressure also has a significant positive effect, with the coefficient value of 0.35 and p-value less than 0.000 on the diffusion of web technologies. In contrast, inconsistent with *H2*, trialability had a positive effect on diffusion, but the significant value was not adequate to consider the significant effect $p > 0.05$. Hence, this hypothesis is not supported by the test. However, results indicated that the diffusion of technologies has a significant effect on the benefits realized by the diffusion. With very high standardized regression weight (0.86, sig. 0.000), results indicated that web technologies have a positive effect on the benefits of web technologies diffusion (Figure 2). Table VII presents a summary of hypothesis testing.

Discussions and implications

The empirical results of this study reveal that four out of five independent factors are significant determinants for the diffusion of web technologies in supply chain management functions, with an R^2 value of 0.58. Consistent with prior findings, top management support has been identified as the most influential factor for web technologies' diffusion (Higgins *et al.*, 1999; Lee *et al.*, 2006; Mosbeh and Soliman, 2008; Ngai *et al.*, 2004; Seyal *et al.*, 2007; Sharma and Gadenne, 2001; Sohail and Teo, 2003; Sureshchandar *et al.*, 2001; Thiagarajan and Zairi, 1998). Such a finding is not unexpected, as without top management support, the implementation of any technological initiatives can be very cumbersome. This implies that it is imperative for top management of firms to be knowledgeable and involved in championing the diffusion process, to guarantee the successful adoption and implementation of SCM functions. This is because with adequate top management support, a proper alignment of the SCM functions and the organizational goals, objectives, and needs can be attained.

Consistent with prior studies (Liao *et al.*, 2011; Mpofu and Watkins-Mathys, 2011), perceived usefulness appears to be the second most influential factor for the diffusion of web technologies. This is not difficult to comprehend as many Malaysian organizations perceive the adoption of any new technologies as expensive (Doolin and Troshani, 2007; Gerrand and Cunningham, 2003; Oh *et al.*, 2003). As such, they would appreciate it if the technologies provided more functionality than current and traditional technologies. This seems to make sense as potential adopters need to first understand the technologies and its benefits, so that risks, inherent in the use of such technologies, can be greatly reduced. This implies that it is imperative for web technologies to fit with the organizational system so that the firms can easily realize or compare the potential benefit of the web technologies, compared to current and traditional technologies. It is also important to educate firms that web technologies are relatively cheaper and more flexible than any other technologies. This will greatly reduce the risk if the trial turns out to be a failure.

Competitive pressure has been identified as the third most influential factor affecting the diffusion of web technologies in SCM functions. This is hardly surprising as competitive pressure has long been recognized as an important factor, leading to the

No.	Hypothesis	Results
H1	There is a positive significant effect of perceived usefulness on rate of diffusion of web technologies in supply chain activities	Accepted
H2	There is a significant positive effect of trialability on the rate of diffusion of web technologies in supply chain activities	Rejected
H3	There is a significant negative effect of complexity on the rate of diffusion of web technologies in supply chain activities	Accepted
H4	There is a positive significant effect of competitive pressure on the rate of diffusion of web technologies in SCM functions	Accepted
H5	There is a significant positive effect of top management support on the rate diffusion of web technologies in SCM functions	Accepted
H6	There is a positive impact of the diffusion of web technologies on the benefits of diffusion of web technologies in SCM	Accepted

Table VII. Summary of hypothesis testing adoption of an innovation (Iacovou *et al.*, 1995; Premkumar and Ramamurthy, 1995; Zhu and Kraemer, 2005; Zhu *et al.*, 2003). It is expected that firms facing stiff competition will take necessary measures, including adopting state-of-the-art technologies in their SCM functions (Gatignon and Robertson, 1989; Teo *et al.*, 2003; To and Ngai, 2006), since SCM by default is recognized as a competitive tool for any successful organization (Lancioni, 2000). With the current competitive business landscape, it is expected that any firm will attempt to follow their competitors in adopting the latest practices, including any technological innovation. This implies the importance of benchmarking other firms which are known to be leaders in technologies adoption, specifically their SCM activities. This is of paramount importance if the firms intend to eliminate their competitors' advantage in a timely manner (Ranganathan *et al.*, 2004).

Most diffusion models have considered that complexity is the key determinant of the diffusion process (Tornatzky and Klein, 1982). Previous research confirms that an innovation with substantial complexity reduces the chances of diffusion of technologies. In this context, all studies found a significant negative relationship between complexity and the diffusion of technologies (Alam *et al.*, 2007; Bradford and Florin, 2003; Doolin and Troshani, 2007; Michelino *et al.*, 2008; Mosbeh and Soliman, 2008). It is also expected that complexity will reduce the diffusion rate of web technologies if it is difficult to understand, install and learn. The findings imply that web technologies would be adopted in firms' supply chain activities if the adoption of such technologies is less complicated for the adopting firm. This implies that it is of paramount importance for top executives to realize the radical improvements to their supply chain activities, by adopting web technologies which requires minimal learning, investment and training.

Rogers (1962) suggested that if the potential adopters have the chance to test or use the innovation before the final adoption then the chances of adoption for that innovation will be high (Agarwal and Prasad, 1997; Tan and Teo, 2000). Much prior research considered it as an important factor for their research model (Chen, 2003; Tan and Teo, 2000; Troshani and Lymer, 2010). They identified important positive associations of trialability with the diffusion process, in different technological contexts. However, this research found a positive not significant relationship between trialablity and the diffusion of web technologies. The primary reason for trialability being insignificant is that a web service can be introduced incrementally into an organization, because preliminary experiments of this standard do not require major IT infrastructure changes (Chen, 2003). Hence, firms have time to use this technology before its final adoption in their organizations. Hence, the importance of trialability could reduce the diffusion process. Moreover, a few other factors, such as a dynamic business environment, faster responses to market needs, and buyer-supplier relationships, force organizations to adopt technologies without wasting time. In many cases, organizations need to diffuse technologies based on their partners' technological standards. In this situation, organizations have no other alternative, and web technologies can fit with almost all standards across the world. Hence, the importance of trialability could be reducing for the diffusion of web technologies. Finally, the Malaysian Government provides many subsidies for technological adoption by firms, such as E-commerce application (Alam *et al.*, 2007). Hence, this could be another reason for trialability being insignificant in the diffusion process for web technologies. Therefore, this research gives a new wave of thinking for the technologies developer, as to whether they provide a trial session for the adopters or not.

One of the main concerns for researchers and practitioners, related with diffusion of technologies, is the benefits resulting from diffusion. Many recent studies try to examine the benefits of diffusion of technologies (Dong *et al.*, 2010; Lin, 2008; Ranganathan *et al.*, 2004; Sanders, 2007; Wiengarten *et al.*, 2011). However, this issue is still not clear. Results of this study showed that there is a significant positive effect of diffusion of web technologies on organizational performance. It indicates that by diffusing web technologies, organizations can reduce inventory cost, foster collaboration, reduce product development time, and make a more accurate demand schedule. These results are consistent with many recent studies (Ranganathan *et al.*, 2004; Wiengarten *et al.*, 2011), that identified the same results and concluded that by using e-business technologies; organizations will be able to improve their performance. Hence, it is worth to concluding that, by diffusing web technologies, organizations can manage their activities effectively and efficiently, which leads to greater organizational performance.

Conclusion and contributions

As more and more organizations are diffusing web technologies into their supply chain functions, it is imperative to empirically examine the factors affecting the diffusion of such technologies, which has received very little attention to date. As Ranganathan *et al.* (2004) opine, there has been little field data available owing to the dominance of analytical modelling and practitioner case studies, which have served as the main approaches in the study of SCM. Drawing upon the theoretical perspectives from different diffusion theories, this study therefore addressed what it intended to investigate. By building on earlier research, this study enriches our insight into the factors affecting the diffusion of web technologies in supply chain activities. The major contributions of this study are highlighted in next section.

This study contributes to the important current issue on web technologies diffusion by providing empirical evidence on the benefits of web technologies, and important determinants influencing diffusion of web technologies. It contributes important real-world knowledge regarding both the diffusion and benefits of the diffusion of web technologies, as a new area where there have been relatively few studies based on empirical data. Similarly, this study justifies strongly that web technologies have a positive effect on organizational performance. Organizations can reduce inventory cost by sharing information in real-time environment and collaboration can result in accurate demand schedules, as these technologies are able to reduce product development time.

From the theoretical view, this study shows how the innovation characteristics can influence the diffusion of web technologies, although one attribute of diffusion was not significant. Similarly, this study also contributes to practitioners. By identifying critical success factors for the diffusion of web technologies, practitioners can develop appropriate strategies for implementing web technologies for their supply chain successfully. Consequently, practitioners will be aware of their most important role for making diffusion successful. This provides evidence that the participation of top management is the most important factor for the successful implementation of web technologies in the supply chain. Moreover, this study assures practitioners that the diffusion of web technologies will provide better organizational performance. Therefore, it is valuable to invest in web technologies for SCM.

Finally, this study provides guidelines for practitioners about the importance of the competitive environment. It shows that the greater the competitive environment, the more responsive the organization should be. Organizations must plan carefully for the implementation of web technologies in SCM in a competitive environment.

Limitation and future research

While every effort has been made to make this study as comprehensive as possible, certain limitations do present themselves, which must be addressed in future research. This study collected data from adopters of web technologies, which could be a potential area for further research. A good extension of research can be based on different units of analysis, such as suppliers or distributors. Another important limitation of this study which leads to a potential area for further research, is cross-validating responses. This study selected only one respondent from one organization which could create complex social judgements about organizational attributes, and can also increase random measurement error. However, due to cost constraints and low response rate, using single respondent is acceptable in organizational based research. Hence, further research could fill this gap by collecting multiple respondents from one organization.

The study examines few variables that influence the effective diffusion of web technologies significantly. There are many other factors yet to be examined for the effective diffusion of web technologies in SCM. These include cultural factors, organizational attributes, readiness, and so on. This is another possible area for future research.

References

Afzal, M.T., Kulathuramaiyer, N., Maurer, H. and Balke, W.T. (2007), "Creating links into the future", *Journal of Universal Computer Science*, Vol. 13 No. 9, pp. 1234-1245.

Agarwal, R. and Prasad, J. (1997), "The role of innovation characteristics and perceived voluntariness in the acceptance of information technologies", *Decision Sciences*, Vol. 28 No. 3, pp. 557-582.

Ahuja, M.K. and Thatcher, J.B. (2005), "Moving beyond intentions and towards the theory of trying: effects of work environment and gender on post-adoption information technologies use", *MIS Quarterly*, Vol. 29 No. 3, pp. 427-459.

Alam, S.S. and Ahsan, N. (2007), "ICT adoption in Malaysian SMEs from service sector: preliminary findings", *Journal of Internet Banking and Commerce*, Vol. 12 No. 3, pp. 1-11.

Alam, S.S., Bakar, Z., Ismail, B.H. and Ahsan, N.M. (2008), "Young consumers online shopping: an empirical study", *Journal of Internet Business*, Vol. 5, pp. 81-98.

Alam, S.S., Khatibi, A., Mohd, I.S.A. and Hishamuddin, B.I. (2007), "Factors affecting e-commerce adoption in the electronic manufacturing companies in Malaysia", *International Journal of Commerce & Management*, Vol. 17 Nos 1/2, pp. 125-139.

Amit, R. and Zott, C. (2001), "Value creation in e-business", *Strategic Management Journal*, Vol. 22 Nos 6/7, pp. 493-520.

Anderson, J.C. and Gerbing, D.W. (1988), "Structural equation modelling in practice: a review and recommended two-step approach", *Psychological Bulletin*, Vol. 103 No. 3, pp. 411-423.

Arbuckle, J.L. and Wothke, W. (1999), *AMOS 4.0 User's Guide*, SmallWaters Corp., Chicago, IL.

Armstrong, J.S. and Overton, T.S. (1977), "Estimating nonresponse bias in mail survey", *Journal of Marketing Research*, Vol. 14, pp. 369-402.

Asare, A.K., Alejandro, T.G.B., Granot, E. and Kashyap, V. (2011), "The role of channel orientation in B2B technologies adoption", *Journal of Business & Industrial Marketing*, Vol. 26 No. 3, pp. 193-201.

Bakker, E., Zheng, J., Knight, I. and Harland, C. (2008), "Putting e-commerce adoption in a supply chain context", *International Journal of Operations & Production Management*, Vol. 28 No. 4, pp. 313-330.

Barua, A. and Mukhopadhyay, T. (2000), "Information technologies and business performance: past, present, and future", in Zmud, R.W. (Ed.), *Framing the Domains of IT Research: Projecting the Future Through the Past*, Pinnaflex Educational Resources, Cincinnati, OH, pp. 65-84.

Benjamin, P.C.Y. and Elsie, O.S.N. (2003), "The migration of electronic commerce (EC): from planning to assessing the impact of EC on supply chain", *Management Decision*, Vol. 41 No. 7, pp. 656-665.

Bernroider, E. and Koch, S. (2001), "ERP selection process in midsize and large organizations", *Business Process Management Journal*, Vol. 7 No. 3, pp. 251-257.

Bigne, J., Enrique, A.J. and Andreu, L. (2008), "B2B services: IT adoption in travel agency supply chain", *Journal of Service Marketing*, Vol. 22 No. 6, pp. 454-464.

Bradford, M. and Florin, J. (2003), "Examining the role of innovation diffusion factors on the implementation success of enterprise resources planning systems", *International Journal of Accounting Information Systems*, Vol. 4, pp. 205-225.

Buonanno, G., Faverio, P., Pigni, F., Ravarini, A., Sciuto, D. and Tagliavini, M. (2005), "Factors affecting ERP system adoption", *Journal of Enterprise Information Management*, Vol. 18 No. 4, pp. 384-426.

Byrne, B.M. (2001), *Structural Equation Modeling with AMOS*, Lawrence Erlbaum Association, Hillsdale, NJ.

Chan, C.H.S. and Ngai, W.T.E. (2007), "A qualitative study of information technologies adoption: how ten organizations adopted web-based training", *Info System Journal*, Vol. 17, pp. 289-315.

Chan, J. (2004), "A conceptual enterprise model for the demand and supply value chains", *ACME 2004 Proceedings of International Conference on Pacific Rim Management*, pp. 314-320.

Chan, O.J. (2005), "Enterprise information systems strategy and planning", *Journal of American Academy of Business, Cambridge*, Vol. 6 No. 2, p. 148.

Chatfield, A.T. and Yetton, P. (2000), "Strategic payoff from EDI as a function of EDI embeddedness", *Journal of Management Information Systems*, Vol. 16, pp. 4 and 195-224.

Chatterjee, D., Grewal, R. and Sambamurthy, V. (2002), "Shaping up for e-commerce: institutional enablers of the organizational assimilation of web technologies", *MIS Quarterly*, Vol. 26 No. 2, pp. 65-89.

Chau, K.Y.P. and Hui, L.K. (2001), "Determinants of small business EDI adoption: an empirical investigation", *Journal of Organizational Computing and Electronic Commerce*, Vol. 77 No. 4, pp. 229-252.

Chen, J. and McQueen, R.J. (2008), "Factors affecting e-commerce stages of growth in small Chinese firms in New Zealand: an analysis of adoption motivators and inhibitors", *Journal of Global Information Management*, Vol. 16 No. 1, pp. 26-60.

Chen, M. (2003), "Factors affecting the adoption and diffusion of XML and web service standards for e-business system", *International Journal of Human-Computer Studies*, Vol. 58, pp. 259-279.

Chong, A.Y., Nathan, D., Keng-Boon, O. and Binshan, L. (2008), "Adoption of 3G services among Malaysian consumers: an empirical analysis", *International Journal of Mobile Communications*, Vol. 8 No. 2, pp. 129-149.

Chong, Y.A. and Ooi, K.B. (2008), "Adoption of interorganizational system standards in supply chains an empirical analysis of RosettaNet standards", *Industrial Management & Data Systems*, Vol. 108 No. 4, pp. 529-547.

Chou, D.C., Tan, X. and Yen, D.C. (2004), "Web technologies and supply chain management", *Information Management & Computer Security*, Vol. 12 No. 4, pp. 338-349.

Churchill, G.A. (1995), *Marketing Research: Methodological Foundations*, 6th ed., Dryden Press, Chicago, IL.

Croom, R.S. (2005), "The impact of e-business on supply chain management an empirical study of key developments", *International Journal of Operation and Production Management*, Vol. 25 No. 1, pp. 55-73.

Davis, F.D., Bagozzi, R.P. and Warshaw, P.R. (1986), "User acceptance of computer technology: a comparison of two theoretical models", *Management Science*, Vol. 35, pp. 982-1003.

Dehning, B. and Richardson, V.J. (2002), "Return of investment technologies: a research synthesis", *Journal of Information System*, Vol. 16 No. 1, pp. 7-30.

DePietro, R., Wiarda, E. and Fleischer, M. (1990), "The context for change: organisation, technologies and environment", in Tornatzky, L.G. and Fleischer, M. (Eds), *The Processes of Technological Innovation*, Lexington Books, Lenxington, MA, pp. 151-175.

Devaraj, S., Krajewski, L. and Wei, J.C. (2007), "Impact of eBusiness technologies on operational performance: the role of production information integration in the supply chain", *Journal of Operations Management*, Vol. 25, pp. 1199-1216.

Dong, J., Han, J., Liu, J. and Xu, H. (2010), "The shallow analysis of the enlightenment of cloud computing to distance education", *E-Health Networking, Digital Ecosystems and Technologies* (*EDT*)*, 2010 International Conference*, pp. 301-303.

Doolin, B. and Ali, H.E. (2008), "Adoption of mobile technologies in the supply chain: an exploratory cross-case analysis", *International Journal of E-Business Research*, Vol. 4 No. 4, pp. 1-15.

Doolin, B. and Troshani, I. (2007), "Organizational adoption of XBRL", *Electronics Markets*, Vol. 17 No. 3, pp. 199-209.

Dow, K.E., Jeffrey, W., Cynthia, J. and Robert, A.L. (2008), "A comparison of structural equation modeling approaches: the case of user acceptance of information systems", *Journal of Computer Information Systems*, Vol. 48 No. 4, p. 106.

Fichman, R.G. (2004), "Real options and IT platform adoption: implications for theory and practice", *Information Systems Research*, Vol. 15 No. 2, pp. 132-154.

Gallagher, P., Lazarus, W., Shapouri, H., Conway, R. and Duffield, J. (2008), "Some health benefits of US clean air policy: a statistical analysis", *International Association for Energy Economics, 2008, Proceedings of the 31st IAEE International Conference, Istanbul, Turkey,18-20 June*, available at: www.iaee.org/en/publications/proceedingssearch.asp%

Gallivan, M.J., Spitler, V.K. and Koufaris, M. (2005), "Does information technologies really matter? A social information processing analysis of coworkers' influence on IT usage in the workplace", *Journal of Management Information Systems*, Vol. 22 No. 1, pp. 153-192.

Gatignon, H. and Robertson, T.S. (1989), "Technologies diffusion: an empirical test of competitive effects", *Journal of Marketing*, Vol. 53 No. 1, pp. 35-49.

Gerrand, P. and Cunningham, J.B. (2003), "The diffusion of internet banking among Singapore consumers", *International Journal of Bank Marketing*, Vol. 21 No. 1, pp. 16-28.

Graham, G. and Hardaker, G. (2000), "Supply chain management across the internet", *International Journal of Physical Distribution and Logistics*, Vol. 30 Nos 3/4, pp. 286-295.

Grover, V. (1993), "Empirically derived model for the adoption of customer-based inter-organizational information system", *Decision Science*, Vol. 24 No. 3, pp. 603-639.

Grover, V. and Goslar, M.D. (1993), "The initiation, adoption, and implementation of telecommunications technologies in the US", *Journal of Management Information Systems*, Vol. 10 No. 1, pp. 141-163.

Hair, J.F., Anderson, R.E., Tatham, R.L. and Black, W.C. (1998), *Multivariate Data Analysis with Readings*, MacMillan, New York, NY.

Hair, J.F., Anderson, R.E., Tatham, R.L. and Black, W.C. (2006), *Multivariate Analysis*, 6th ed., Prentice-Hall International, Upper Saddle River, NJ.

Hair, J.F., Anderson, R.E., Tatham, R.L. and Black, W.C. (2008), *Multivariate Analysis*, 7th ed., Prentice-Hall International, Upper Saddle River, NJ.

Harrison, T. and Waite, K. (2005), "Critical factors affecting intermediary web site adoption: understanding how to extend e-participation", *Journal of Business & Industrial Marketing*, Vol. 20 Nos 4/5, pp. 187-199.

Hiasson, M.W. and Lovato, C.Y. (2001), "Factors influencing the formation of a user's perceptions and use of a DSS software innovation", *The DATA BASE for Advances in Information Systems*, Vol. 32 No. 3, pp. 16-35.

Higgins, H., Susan, H. and Hogan, T.P. (1999), "Internal diffusion of high technology industrial innovations: an empirical study", *Journal of Business & Industrial Marketing*, Vol. 14 No. 1, pp. 61-75.

Ho, L. (2008), "What affects organizational performance? The linking of learning and knowledge management", *Industrial Management and Data System*, Vol. 108 No. 9, pp. 1234-1254.

Holmes-Smith, P. (2002), *Applied Structural Equation Modelling*, February, Canberra.

Hulland, J., Chow, Y.H. and Lam, S. (1996), "Use of causal models in marketing research: a review", *International Journal of Research in Marketing*, Vol. 13, pp. 181-197.

Husnayati, H. and Rafidah, M.N. (2005), "Innovating business through e-commerce: exploring the willingness of Malaysian SMEs", paper presented at The Second International Conference on Innovations in IT (IIT'05).

Hwang, Y. (2004), "The influence of individual-level cultural orientation on ERP system adoption", *AMCIS 2004 Proc., New York, 5-8 August*.

Iacovou, C.L., Benbasat, I. and Dexter, A.S. (1995), "EDI and small organizations: adoption and impact of technologies", *MIS Quarterly*, Vol. 19 No. 4, pp. 465-485.

IDC (2009), *Regional Information Technology Report*, available at: www.idc.com.my/PressFiles/IDC%20Malaysia%20-%202009%20Top%2010%20Predictions%20of%20the%20M%27sia%20ICT.asp (accessed 14 March 2011).

Ifinedo, P. (2011), "Internet/e-business technologies acceptance in Canada's SMEs: an exploratory investigation", *Internet Research*, Vol. 21 No. 3, pp. 255-281.

Intan, S.M., Marthandan, G., Norzaidi, M.D. and Normah, O. (2008), "Malaysia e-commerce and value creation: empirical evidence in Malaysia tourism sector", *2008 EABR and TLC Conferences Proceedings Rothenburg, Germany International Bled Electronic Commerce Conference, Bled, Slovenia, 25-26 June*.

Jaakkola, E. and Renko, M. (2007), "Critical innovation characteristics influencing the acceptability of a new pharmaceutical product format", *Journal of Marketing Management*, Vol. 23 Nos 3/4, pp. 327-346.

Jeyaraj, A., Rottman, J.W. and Lacity, M.C. (2006), "A review of the predictors, linkages, and biases in IT innovation adoption research", *Journal of Information Technologies*, Vol. 21, pp. 1-23.

Johnston, A.B. and Vitale, M.R. (1988), "Creating competitive advantage with interorganizational information systems", *MIS Quarterly*, Vol. 12 No. 4, pp. 153-166.

Julien, P.A. and Raymond, L. (1994), "Factors of new technologies adoption in the retail sector", *Entrepreneurship: Theory and Practice*, Vol. 18 No. 5, pp. 79-90.

Kanuk, L. and Berenson, C. (1975), "Mail surveys and response rates: a literature review", *Journal of Marketing Research*, Vol. 12, pp. 440-453.

Kim, C. and Galliers, D.R. (2004), "Toward a diffusion model for internet systems", *Internet Research*, Vol. 14 No. 2, pp. 155-166.

Kimberly, J.R. and Evanisko, M.J. (1981), "Organizational innovation: the influence of individual, organizational, and contextual factors on hospital adoption of technological and administrative innovations", *Academy of Management Journal*, Vol. 24, pp. 689-713.

Kline, R.B. (2005), *Principles and Practice of Structural Equation Modeling*, 2nd ed., Guilford Press, New York, NY.

Kogilah, N., Santhapparaj, A.S. and Eze, U.C. (2008), "An empirical study of website adoption among small and medium enterprises in Malaysia", *Proceedings of the 10th IBIMA Conference on Innovation and Knowledge Management in Business Globalisation*, pp. 339-351.

Kohli, R. and Devaraj, S. (2003), "Measuring information technologies payoff: a meta-analysis of structural variables in firm-level empirical research", *Information Systems Research*, Vol. 14 No. 2, pp. 127-145.

Lancioni, R. (2000), "New development in supply chain management for the millennium", *Industrial Marketing Management*, Vol. 29 No. 1, pp. 1-6.

Lancioni, R.A., Smith, M. and Oliva, T.A. (2000), "Role of the internet in supply chain management", *Industrial Marketing Management*, Vol. 29, pp. 45-56.

Lee, H.L. and Whang, S. (2001), *E-business and Supply Chain Integration*, Stanford Global Supply Chain Management Forum, Stanford, CA.

Lee, Y.P., Zailani, S. and Soh, K.L. (2006), "Understanding factors for benchmarking adoption", *Benchmarking: An International Journal*, Vol. 13 No. 5, pp. 548-565.

Li, Y. (2011), "ERP adoption in Chinese small enterprise: an exploratory case study", *Journal of Manufacturing Technologies Management*, Vol. 22 No. 4, pp. 489-505.

Liao, C., Pui-Lai, T., Chuang-Chun, L., Pu-Yuan, K. and Shu-Hui, C. (2011), "Factors influencing the intended use of web portals", *Online Information Review*, Vol. 35 No. 2, pp. 237-254.

Lin, C. (2008), "Determinants of the adoption of technological innovation by logistics service providers in China", *International Journal of Technologies Management and Sustainable Development*, Vol. 7 No. 1, pp. 19-38.

Lin, F. and Wu, J. (2004), "An empirical study of end-user computing acceptance factors in small and medium enterprise in Taiwan: analyzed by structural equation modeling", *Journal of Computer Information System*, Spring, pp. 98-108.

Liu, Y., Han, S. and Li, H. (2010), "Understanding the factors driving m-learning adoption: a literature review", *Campus-Wide Information Systems*, Vol. 27 No. 4, pp. 210-226.

Lopez, A.V. and Iglesias, S. (2010), "A reputational performance framework in an SME context: some empirical evidence from Spain", *The IRISH Journal of Management*, Vol. 3 No. 2, pp. 35-66.

Mahmood, M.A. and Szewczak, E.J. (1999), *Measuring Information Technologies Investment Payoff: Contemporary Approaches*, IGI Global, Hershey, PA.

Malhotra, N.K. (1999), *Marketing Research: An Applied Orientation*, 3rd ed., Prentice-Hall, Upper Saddle River, NJ.

Maruyama, G.M. (1998), *Basic of Structural Equation Modeling*, Sage, Thousand Oaks, CA.

Melville, N., Kraemer, K. and Gurbaxani, V. (2004), "Review: information technology and organizational performance: an integrative model of IT business value", *MIS Quarterly*, Vol. 28 No. 2, pp. 283-322.

Michelino, F., Bianco, F. and Mauro, C. (2008), "Internet and supply chain management: adoption modalities for Italian firms", *Management Research News*, Vol. 31 No. 5, pp. 359-374.

Migiro, O.S. (2006), "Diffusion of ICTs and e-commerce adoption in manufacturing SMEs in Kenya", *SA Jnl. and Info. Sci.*, Vol. 72 No. 1, p. 35.

Money, W. and Turner, A. (2004), "Application of the technologies acceptance model to a knowledge management system", *Proceedings of the 37th Hawaii International Conference on System Sciences 2001, IEEE.*

Mosbeh, R. and Soliman, S.K. (2008), "An exploratory of factors affecting users adoption of corporate intranet", *Management Research News*, Vol. 31 No. 5, pp. 375-385.

Mpofu, K.C. and Watkins-Mathys, L. (2011), "Understanding ICT adoption in the small firm sector in Southern Africa", *Journal of Systems and Information Technologies*, Vol. 13 No. 2, pp. 179-199.

Mukhopadhyay, T. and Kekre, S. (2002), "Strategic and operational benefits of electronic integration in B2B procurement processes", *Management Science*, Vol. 48 No. 10, pp. 1301-1313.

Nabeel, Q. (2007), "The adoption of eCommerce communications and applications technologies in small businesses in New Zealand", *Electronic Commerce Research and Applications*, Vol. 6 No. 4, pp. 462-473.

Ngai, E.W.T., Poon, J.K.L. and Chan, Y.H.C. (2007), "Empirical examination of the adoption of WebCT using TAM", *Computers & Education*, Vol. 48 No. 2, pp. 250-267.

Nikolaeve, R. (2006), "E-commerce adoption in the retail sector: empirical insights", *International Journal of Retail & Distribution Management*, Vol. 34 Nos 4/5, pp. 369-387.

Norzaidi, D.M., Chong, C.S. and Salwani, I.M. (2008), "Perceived resistance, user resistance and managers' performance in the Malaysian port industry", *Aslib Proceedings: New Information Perspective*, Vol. 60 No. 3, pp. 242-264.

Nunally, M.C. and Berstein, I.H. (1994), *Psychometric Theory*, 3rd ed., McGraw Hill, New York, NY.

Obra-Aguila, A.R. and Melendez-Padilla, A. (2006), "Organizational factors affecting internet technology adoption", *Internet Research*, Vol. 16 No. 1, pp. 94-110.

Oh, S., Anh, J. and Kim, B. (2003), "Adoption of broadband internet in Korea: the role of experience in building attitudes", *Journal of Information Technologies*, Vol. 18, December, pp. 267-280.

Pan, M. and Jang, W. (2008), "Determinants of the adoption of enterprise resource planning within the technologies-organization-environment framework: Taiwan's communication industry", *The Journal of Computer Information System*, Vol. 48 No. 3, pp. 94-102.

Peansupap, V. and Walker, D. (2005), "Factors affecting ICT diffusion: a case study of three large Australian construction contractors", *Engineering, Construction and Architectural Management*, Vol. 12 No. 1, pp. 21-37.

Pinho, J.C., Maria, L.M. and Isabel, M. (2011), "The effect of online service quality factors on internet usage: the web delivery system of the taxation department", *International Journal of Quality & Reliability Management*, Vol. 28 No. 7, pp. 706-722.

Pires, G.D. and Aisbett, J. (2001), *A Dual Marketing and Informational Perspective to E-commerce Adoption*, The Newcastle University Research Publications, Newcastle upon Tyne.

Power, D. (2005), "Determinants of business-to-business e-commerce implementation and performance: a structural model", *Supply Chain Management: An International Journal*, Vol. 10 No. 2, pp. 96-113.

Power, D., Hanna, V., Singh, P.J. and Samson, D. (2010), "Electronic markets, data access and collaboration: relative value to performance in firm operations", *Supply Chain Management: An International Journal*, Vol. 15 No. 3, pp. 238-251.

Premkumar, G. and Ramamurthy, K. (1995), "The role of interorganizational and organizational factors on the decision mode for adoption of interorganizational systems", *Decision Science*, Vol. 26 No. 3, pp. 303-336.

Rajendran, L., Schneider, A., Schlechtingen, G., Weidlich, S., Ries, J., Braxmeier, T., Schwille, P., Schulz, J.B., Schroeder, C., Simons, M., Jennings, G., Knölker, H.J. and Simons, K. (2008), "Efficient inhibition of the Alzheimer's disease betasecretase by membrane targeting", *Science*, Vol. 320, pp. 520-523.

Ramamurthy, K., Premkumar, G. and Michael, R.C. (1999), "Organizational and interorganizational determinants of EDI diffusion and organizational performance: a causal model", *Journal of Organizational Computing and Electronic Commerce*, Vol. 9 No. 4, pp. 253-285.

Ranchhod, A. and Zhou, F. (2001), "Comparing respondents of e-mail and mail survey: understanding the implications of technologies", *Marketing Intelligence & Planning*, Vol. 19 No. 4, pp. 254-262.

Ranganathan, C., Dhaliwal, J.S. and Teo, T.S.H. (2004), "Assimilation and diffusion of web technologies in supply chain management: an examination of key drivers and performance impacts", *International Journal of Electronic Commerce*, Vol. 9 No. 1, pp. 127-161.

Raymond, L. (2001), "Determinants of web site implementation in small business", *Internet Research*, Vol. 11 No. 5, pp. 411-422.

Raymond, L. and Uwizeyemungu, S. (2007), "A profile of ERP adoption in manufacturing SMEs", *Journal of Enterprise Information Management*, Vol. 20 No. 4, pp. 487-502.

Robert, G.K.J. and Pick, B.J. (2004), "Technologies factors in corporate adoption of mobile cell phones: a case study analysis", *Proceedings of the 37th Hawaii International Conference of System Science, IEEE Computer Society*.

Rogers, E.M. (1962), *Diffusion of Innovations*, The Free Press, New York, NY.

Rogers, E.M. (1983), *Diffusion of Innovations*, The Free Press, New York, NY.

Russell, M., Dawn, M. and Hoag, M.A. (2004), "People and information technologies in the supply chain social and organizational influence on adoption", *International Journal of Physical Distribution Management*, Vol. 34 No. 2, pp. 102-122.

Sanders, N.R. (2007), "The benefits of using e-business technologies: the supplier perspective", *Journal of Business Logistics*, Vol. 28 No. 2, pp. 177-207.

Schmacker, R.E. and Lomax, R.G. (1996), *A Beginners Guide to Structural Equation Modeling*, Lawrence Erlbaum Association, Hillsdale, NJ.

Sekaran, U. and Bougie, R. (2010), *Research Methods for Business: A Skill Building Approach*, 5th ed., Wiley, New York, NY.

Seyal, H.A., Mohd, N.A.R. and Hj Awg, Y.H.A.M. (2007), "A quantitative analysis of factors contributing electronic data interchange adoption among Bruneian SMEs: a pilot study", *Business Process Management Journal*, Vol. 13 No. 5, pp. 728-746.

Sharma, B. and Gadenne, D. (2001), "An investigation of the perceived importance and effectiveness of quality management approaches", *The TQM Magazine*, Vol. 13 No. 6, pp. 433-443.

Shih, D., Chin, Y., Chang, S. and Yen, D. (2008), "An empirical study of factors affecting RFID's adoption in Taiwan", *Journal of Global Information Management*, Vol. 16 No. 2, pp. 58-80.

Sohail, M.S. and Teo, B.H. (2003), "TQM practices and organizational performance of SMEs in Malaysia: some empirical observation", *Benchmarking: An International Journal*, Vol. 10 No. 1, pp. 37-53.

Stabell, C. and Fjeldstad, O. (1998), "Configuring value for competitive advantage: on chains, shops, and networks", *Strategic Management Journal*, Vol. 19, pp. 413-437.

Subramani, R.M. (2003), "How do suppliers benefit from information technology use in supply chain relationships?", *MIS Quarterly*, Vol. 28 No. 1, pp. 45-73.

Suraya, R. and Mazhatul, Y. (2005), "Internet diffusion and e-business opportunities amongst Malaysian travel agencies", *Journal of American Academy of Business, Cambridge*, Vol. 6 No. 1, pp. 78-84.

Sureshchandar, G.S., Rajendran, C. and Anantharaman, R.N. (2001), "A holistic model for total quality service", *International Journal of Service Industry Management*, Vol. 12 No. 4, pp. 378-412.

Talib, F., Rahman, Z. and Qureshi, M.N. (2010), "A study of total quality management and supply chain management practices", *International Journal of Productivity and Performance Management*, Vol. 60 No. 3, pp. 268-288.

Tan, C. (2006), *Towards Progress*, Computerworld Malaysia, July.

Tan, M. and Teo, T.S.H. (2000), "Factors influencing the adoption of internet banking", *Journal of the Association for Information Systems*, Vol. 13 No. 5, pp. 1-42, July.

Tarofder, A.K., Marthandan, G. and Ahasanul, H. (2010), "Critical factors for diffusion of web technologies for supply chain management functions: Malaysian perspective", *European Journal of Social Science*, Vol. 12 No. 3, pp. 490-505.

Teo, H.H., Wei, K.K. and Benbasat, I. (2003), "Predicting intention to adopt interorganisational linkages: an institutional perspective", *MIS Quarterly*, Vol. 27 No. 1, pp. 19-49.

Thiagarajan, T. and Zairi, M. (1998), "An empirical analysis of critical factor of TQM", *Benchmarking for Quality Management & Technology*, Vol. 5 No. 4, pp. 291-303.

To, M.L. and Ngai, H.W.T. (2006), "Predicting the organisational adoption of B2C e-commerce: an empirical study", *Industrial Management & Data Systems*, Vol. 106 No. 8, pp. 1133-1147.

Tornatzky, L.G. and Klein, K.J. (1982), "Innovation characteristics and innovation adoption-implementation: a meta-analysis of findings", *IEEE Transactions on Engineering Management*, Vol. EM-29 No. 1, pp. 28-45.

Troshani, I. and Lymer, A. (2010), "Translation in XBRL standardization", *Information Technology & People*, Vol. 23 No. 2, pp. 136-164.

Upadhyay, P., Jahanyan, S. and Dan, P.K. (2011), "Factors influencing ERP implementation in Indian manufacturing organizations: a study of micro, small and medium-scale enterprises", *Journal of Enterprise Information Management*, Vol. 24 No. 2, pp. 130-145.

Wade, M. and Hulland, J. (2004), "The resource-based view and information systems research: review, extension, and suggestions for future research", *MIS Quarterly*, Vol. 28 No. 1, pp. 107-142.

Wang, W. (2010), "Diffusion of innovation, perceived security and experience: the case of online banking service adoption in Taiwan", *The Business Review, Cambridge*, Vol. 115 No. 2, pp. 247-252.

Warrts, E.V., Everdingen, Y.M. and Hillegersberg, J. (2002), "The dynamics of factors affecting the adoption of innovations", *The Journal of Product Innovation Management*, Vol. 19, pp. 412-423.

Wiengarten, F., Fynes, B., Humphreys, P., Roberto, C.C. and McKittrick, A. (2011), "Assessing the value creation process of e-business along the supply chain", *Supply Chain Management: An International Journal*, Vol. 16 No. 4, pp. 207-219.

Yeh, Y. (2005), "Identification of factors affecting continuity of cooperative electronic supply chain relationship: empirical case of the Taiwanese motor industry", *Supply Chain Management: An International Journal*, Vol. 10 No. 4, pp. 327-335.

Yeung, M.A., Shim, J.P. and Lai, A.Y.K. (2003), "Factor affecting e-commerce adoption: an empirical evidence", *Communication of the ACM*, Vol. 46 No. 9, pp. 226-232.

Zheng, V. (2011), "The value proposition of adopting mCRM strategy in UK SMEs", *Journal of Systems and Information Technologies*, Vol. 13 No. 2, pp. 223-245.

Zhu, K. and Kraemer, K. (2005), "Post-adoption variations in usage and value of e-business by organizations: cross-country evidence from the retail industry", *Information Systems Research*, Vol. 16 No. 1, pp. 61-84.

Zhu, K., Kraemer, K. and Xu, S. (2003), "Electronic business adoption by European firms: a cross-country assessment of the facilitators and inhibitors", *European Journal of Information Systems*, Vol. 12 No. 4, pp. 251-268.

Further reading

Auger, P. and Gallaugher, P. (1997), "Factors affecting the adoption of an internet based sales for small business", *The Information Society*, Vol. 13, pp. 55-74.

Gallear, D., Ghobadian, A. and O'Regan, N. (2008), "Digital/web-based technology in purchasing and supply chain management: a UK study", *Journal of Manufacturing Technology Management*, Vol. 19 No. 3, pp. 346-360.

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