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Recommended Citation

Mangalaraj, George; Jeyaraj, Anand; and Prater, Edmund, "Technology Adoption in Supply Chain Management: A Meta-Analysis of Empirical Findings" (2006). *AMCIS 2006 Proceedings*. 30.
<http://aisel.aisnet.org/amcis2006/30>

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Technology Adoption in Supply Chain Management: A Meta-Analysis of Empirical Findings

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ABSTRACT

Electronic linkages between organizations are an important aspect of modern day supply chains. Organizations implement disparate information / communication systems to integrate their suppliers and customers in a supply chain. Though the underlying technologies and protocols of such information systems may differ, they do possess a common characteristic: they all span boundaries of the supply chain partners. Collectively labeling such systems as supply chain management information systems (SCM-IS), we examine a variety of information systems that support the activities in a supply chain. Specifically, we examine two distinct phenomena related to these information systems: the intention to adopt SCM-IS and the adoption of SCM-IS. Using empirical findings from prior literature, we conduct a meta-analysis to understand the antecedents of the intention to adopt SCM-IS and the adoption of SCM-IS.

Keywords

Information systems, supply chain, adoption, intention to adopt, meta-analysis

INTRODUCTION

Supply chains are becoming increasingly important to organizational operations. Supply chains generally encompass all activities associated with the production of goods, from raw materials to the delivery of the finished products to end-users. In order to gain operational efficiencies, organizations are not only concerned about their internal operations but also their external operations involving suppliers and customers. Supply chain management (SCM) involves the management of relationships, information flows, and material flows across organizational boundaries (Filbeck et al. 2005).

SCM initiatives are known to benefit organizations considerably. For instance, the integration of SCM activities can provide sustainable competitive advantage to organizations (Handfield et al. 1999). Industry leaders in SCM realize higher market capitalization as compared to others (D'Avanzo et al. 2003). Even public announcements of SCM initiatives resulted in organizational benefits in the form of increased market wealth as the stock markets reacted favorably to such initiatives (Filbeck et al. 2005).

Thus, the adoption of or the intention to adopt SCM initiatives assumes considerable importance. SCM initiatives generally include some type of information systems (IS), referred to as SCM-IS hereafter, that allow organizations to undertake their supply chain activities. In this study, we examine the antecedents of an organization's intention to adopt or the adoption of SCM-IS. Specifically, we employ meta-analysis methods to accumulate findings from prior empirical research on the adoption or intention to adopt SCM systems.

SUPPLY CHAIN MANAGEMENT INFORMATION SYSTEMS

A critical element of any SCM initiative is the flow of information in a supply chain. A variety of information systems are used for streamlining such information flows (Cavinato 2005). The importance of information systems in SCM can be gauged by the presence of 7 IS-related initiatives among the 19 SCM initiatives identified by Cavinato (2005). Integrated information systems are utilized for adding value along the supply chain and (Gunasekaran et al. 2004) call information technology to be the nerve system for SCM.

These systems allow organizations to exchange information with their supply chain partners through electronic communication networks. We define SCM-IS as information systems shared and used by two or more partners in a supply chain. Examples of SCM-IS include electronic data interchange (EDI), inter-organizational systems (IOS), financial electronic data interchange (FEDI), etc. (Grover 1993; Plouffe et al. 2001).

SCM-IS are somewhat different from that of traditional information systems (Premkumar et al. 1997). Unlike traditional information systems, SCM-IS span multiple organizations, such as the organization's suppliers, customers, and/or collaborators. Further, the adoption of SCM-IS is not a unilateral decision for the organization. Rather, it requires the cooperation and commitment of the participating firms in a supply chain. In all likelihood, organizations may engage in economic and business relationships with their partner organizations.

RESEARCH MODEL

Figure 1 shows the overall research model for understanding SCM-IS adoption. Our research model is generally consistent with prior conceptualizations of information systems adoption and diffusion. In general, organizational responses to innovations can be examined in two stages: pre-adoption and post-adoption. We distinguish between these stages by using two dependent variables: intention to adopt SCM-IS and adoption of SCM-IS (Ajzen 1991; Fishbein et al. 1975; Rogers 1983). Further, these behaviors are influenced by the perceived expected benefits of the innovation, attributes of the innovation, organizational characteristics, and environmental characteristics (Bouchard 1993a; Bouchard 1993b; Chwelos et al. 2001; Iacovou et al. 1995; Kwon et al. 1987; Rogers 1995; Teo et al. 2003).

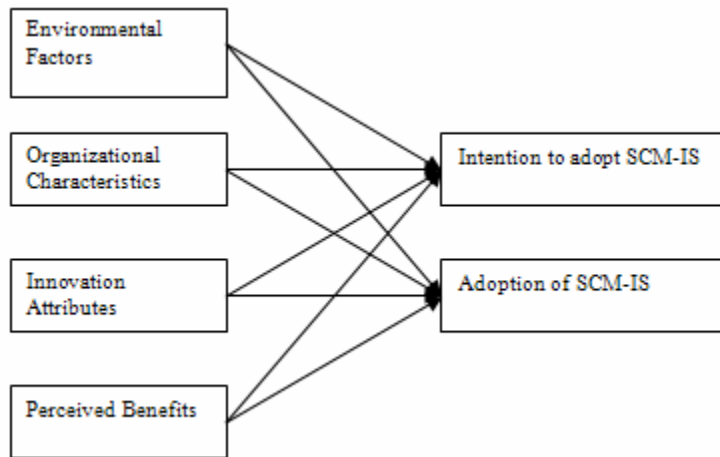


Figure 1. Research Model

Intention to Adopt SCM-IS

During the pre-adoption stage represented by intention to adopt, the organization has not yet made a commitment to the SCM-IS and has not directed any resources towards it. In all likelihood, the organization has not used the SCM-IS but may have heard about the innovation from other sources. The organization may even be gathering information about the innovation in an attempt to form or revise its opinion of the innovation. Several factors may act together to determine the organization's reasons for or against the innovation. Thus, the organization is probably engaging in an intellectual exercise to weigh the pros and cons of adopting SCM-IS. Research studies in the past have explored this construct in great detail in different contexts. Chwelos et al. (2001) has used it as the dependent variable for their model for EDI adoption.

Adoption of SCM-IS

During the adoption stage of SCM-IS, the organization has already made a huge investment in acquiring and implementing the SCM-IS. The organization probably has instituted internal mechanisms, such as training and technical support, by which the innovation can be dispersed for everyday use by its members. Iacovou et al. (1995) in the context of EDI adoption characterize it as the process by which an organization is capable of carrying out electronic transactions with its partners. Due to the nature of SCM-IS, the organization relies on its partners, such as suppliers and customers, to effectively make use of the innovation and realize value for its investment. Thus, the organization has a vested interest in the success of the innovation and may engage in activities to achieve such success.

Environmental Factors

Organizations typically respond to the environment in which they conduct their everyday operations (DiMaggio et al. 1983). In the context of SCM-IS, environmental factors are all the more salient since SCM-IS necessarily affects other organizations as well. Organizations have to contend with environmental factors even when they may have their own internal reasons vis-à-vis the SCM-IS. Prior studies have found empirical support for the importance of environmental factors in the adoption process (Bouchard 1993a; Iacovou et al. 1995; Teo et al. 2003).

Organizational Characteristics

Organizations are generally distinctive in character and possess unique capabilities. They formulate and implement strategies for successfully competing in their chosen environments, in accordance with their own distinctive natures, such as innovativeness, and immediate needs (Rogers 1983). Chwelos et al. (2001) highlight the distinct nature of systems that span multiple organizations and state that adoption of such systems is an organizational decision that is taken in the inter-organizational context. In the context of SCM-IS, organizations may evaluate their own readiness and resources in making adoption-related decisions (Chwelos et al. 2001). Prior studies have shown that organizational characteristics are important in the adoption process (Grover 1993; Premkumar 2003).

Innovation Attributes

Innovations can typically be described in terms of their attributes. Organizations generally evaluate the attributes of an innovation in making their adoption-related decisions (Rogers 1983). In the context of SCM-IS, innovation attributes such as cost of the innovation may be important determinants of adoption. Prior studies have demonstrated that innovation attributes play a vital role in the adoption process (Moore et al. 1991; Plouffe et al. 2001; Ramamurthy et al. 1995).

Perceived Benefits

Innovations are generally expected to provide benefits to the adopter organizations (DeLone et al. 1992). In general, organizations evaluate the extent to which they can gain future benefits from adopting an innovation. In the context of SCM-IS, organizations may realize tangible or intangible future benefits in adopting the innovation (Pfeiffer 1992). Prior literature has emphasized the importance of perceived future benefits in the adoption process (Chwelos et al. 2001; Ferguson et al. 1990).

RESEARCH METHOD

We employed meta-analysis procedures (Hunter et al. 1990) to examine our research model. Meta-analysis is a quantitative technique that can be used to accumulate prior empirical findings without access to the original study data (Alavi et al. 1992). Meta-analysis involves three broad steps: retrieving relevant studies, coding the findings reported by individual studies, and accumulating findings.

Retrieving relevant studies: We included studies on SCM-IS published between 1990 and 2006 for our analysis. To minimize publication bias, we considered several publication outlets such as journals, conference proceedings, and doctoral dissertations (Lipsey et al. 2000). To consider the wide spectrum of SCM-IS in our analysis (Cavinato 2005), we included various types of systems such as EDI, IOS, business-to-business (B2B), portals, extranets, etc. To actually identify the studies, we searched various online databases such as ABI/Inform, EBSCO, and Social Science Citation Index. We used search terms such as “adoption,” “intention to adopt,” “diffusion,” “implementation,” “EDI,” “electronic data interchange,” “inter-organizational systems,” “B2B,” etc. We also used the references published at the end of various studies to find more studies for inclusion in our analysis. Our search procedures resulted in more than 350 studies.

Coding findings reported by individual studies: For each relationship between an independent variable and a dependent variable examined, several artifacts need to be coded from individual studies for the meta-analysis (Hunter et al. 1990). These include the effect size, the sample size, and the reliabilities of the independent and dependent variables (Hunter et al. 1990; Lipsey et al. 2000). To uniformly code findings from the individual studies, we have developed common coding sheets.

Accumulating findings: Finally, the findings coded from the individual studies should be accumulated using meta-analysis procedures. This is accomplished in several steps as follows (Hunter et al. 1990; Lipsey et al. 2000). First, we correct for sampling errors by computing the weighted effect sizes for individual studies and then the average of the weighted effect sizes. Second, we correct for measurement errors by attenuating the effect sizes using product of the square roots of the reliabilities of the independent and dependent variables. Finally, we attenuated the partially corrected correlation by the average of the reliabilities of the independent and dependent variables for those studies with missing reliabilities.

CONCLUSION

We are in the process of reviewing the more than 350 studies to isolate those articles that may be included in the meta-analysis. Meta-analysis procedures require empirical findings reported in certain forms; and studies that do not provide such statistics would have to be eliminated from the meta-analysis (Hunter et al. 1990). For instance, conceptual essays, qualitative studies, and reviews may have to be excluded from the meta-analysis. Once this process is complete, we plan to engage in the “coding” and “accumulating” phases of the meta-analysis. We will present preliminary findings at the annual conference.

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