Inter-Organizational Information Systems in the Supply Chain

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INTRODUCTION

Information technologies are important enablers of coordination and collaboration in supply chains (Chong, Ooi, & Sohal, 2009). In particular, inter-organizational information systems (also referred to as inter-organizational systems or IOS) enable collaborative business practices between organizations with remarkable productivity gains. IOS can serve many purposes, e.g., support virtual teams or project management. One important application area of IOS is the supply chain in which sellers and buyers constantly interact to ensure a flow of goods from sources to final consumers.

Due to their boundary-spanning nature and comprehensive support of business processes IOS in supply chains are a highly interdisciplinary and complex research field. Since the development of the first systems in the 1960s IOS have undergone dramatic changes, particularly due to the Internet. Thus research on IS and other disciplines (supply chain management, marketing, operations research etc.) accumulated a large body of knowledge on IOS technologies, usage, and consequences. Many findings are highly consistent, but some are contradicting and thus highlight the need for future research in this field (Robey, Im, & Wareham, 2008).

The goal of this article is a systematic discussion of insights into relevant IOS issues from an IS research perspective. It addresses the academic debate on drivers, types, and impacts of IOS in the supply chain and seeks to contribute to a clear understanding of the business and technical implications of IOS. For this purpose, we draw on the technology-organization-environment framework (T-O-E) by Tornatzky & Fleischer (1990) and the theory of diffusion of innovations (Rogers, 1995). The T-O-E framework discusses the technological, organizational, and environmental context of innovations or IS. We extend this framework by accounting for two dimensions in the organizational view that originate from the diffusion of innovations theory. That theory distinguishes between leaders' attitudes as well as organizational conditions of innovations. Thus we apply two dimensions of the organizational view: organizational behavior (that is, managers' decisions) and organizational conditions that cannot be changed in the short run. We further add the economic outcome of IOS usage and consider its benefits and costs including strategic and operational consequences on business processes. Based on this extended framework we discuss IOS from five perspectives:

- **The Technological View:** IOS technologies and IOS standards.
- **The Organizational Behavior View:** Purpose, levels, and drivers of IOS usage.
- **The Organizational Conditions View:** Organizational factors that influence IOS usage.
- **The Environmental View:** Inter-organizational and further external factors that influence IOS usage.
- **The Economic View:** Strategic and operational benefits and costs of IOS usage.

The article first discusses the conceptual background and practical relevance of IOS usage. Then it elaborates the above-mentioned five views and presents key findings of seminal, primarily IS research. The article concludes with an outlook on future research directions on IOS in the supply chain.

BACKGROUND

IOS are information systems that electronically link organizations with other organizations to facilitate information exchange between them (Riggins &

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Mukhopadhyay, 1994). IOS can function as enablers of many modified business processes as well as intensified inter-organizational relationships. The key to these IOS-induced changes is the possibility to exchange information to an extent that would not be feasible without IOS (Madlberger, 2009). Examples are competitive advantages and benefits obtained by IOS (Riggins and Mukhopadhyay 1994; Mukhopadhyay, Kekre and Kalathur 1995), impacts on inter-organizational business processes (Lee, Clark, & Tam, 1999), and IOS-based alliances and relationships (Gurbaxani &Whang 1991; Kumar & van Dissel, 1996). IOS thus imply "a level of cooperation and coordination well beyond that of the traditional arms-length relationship that exists between organizations acting as free-agents in a market" (Kumar & van Dissel, 1996 p. 279).

IOS and IOS-based collaboration play a major role in business practice. Particularly in supply chain management a large number of collaboration models emerged that could not be conducted without IOS. Since the 1990s companies in the U.S. and Europe are engaged in efficient consumer response (ECR) initiatives that involve not only connected business information, but also supply chain and consumer marketing collaboration (ECR Europe, 2014). Concrete examples of IOS-based collaboration initiatives are vendor-managed inventory (VMI), cross docking, or collaborative planning, forecasting, and replenishment that all depend on an intensive and frequent information sharing that can only be facilitated electronically (Madlberger, 2009). For example, VMI requires the vendor to manage the buyer's inventory and suggest autonomously delivery quantities and time, resulting in inventory, production, and transport optimization (Derry, 2013) based on a regular exchange of inventory report data and dispatch advices. According to a recent study on usage in the Austrian fast moving consumer goods IOS usage and IOS-based collaboration result in an improved customer service, optimized business processes as well as an intensified and improved relationship between manufacturers and retailers (Madlberger & Foscht, 2011).

THE TECHNOLOGICAL VIEW ON IOS

IOS Technologies

Technically speaking, IOS comprise "a collection of IT resources, including communications networks, hardware IT applications, standards for data transmission, and human skills and experiences" (Williamson, Harrison, & Jordan, 2004, p. 376). The most important IOS technologies are the following:

- **Electronic Data Interchange (EDI) Systems:** These systems are proprietary, but independent from different hardware, software, and communications systems. They offer standardized business documents in text format that are readable and processible via EDI converters (Narayanan, Marucheck, & Handfield, 2009).
- **XML-Based Electronic Data Interchange:** Systems in this category are XML/EDI or specific standards in XML format, such as ebXML.
- **Internet-Based IOS:** Application of the Internet for electronic data interchange that replaces the proprietary infrastructure (Huang, Janz, & Frolick, 2008). Internet-based IOS can be operated by companies (e.g., a Web portal as an extranet) or by electronic marketplaces.

Besides these dedicated IOS, further systems can be used in an inter-organizational context. The most relevant ones are:

- **Web Service-Based IOS:** Application of open standards based on the Web services architecture for inter-organizational data exchange (Daniel & White, 2005). The main focus of Web services are data type standards, schema expression languages, and common methods of communication. Web services can also be combined with XML-based standards, such as ebXML or the Universal Business Language (Albrecht, Dean, & Hansen, 2005).
- **Enterprise Resource Planning (ERP) Systems:** Applications in ERP systems that allow inter-organizational data exchange (Daniel & White, 2005). Usually ERP systems include EDI software (for example the Intermediate Documents IDoc in SAP systems).

In practice, the combination of several IOS technologies to facilitate an inter-organizational information flow is common. Examples are ERP systems that