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Interorganizational Information Systems

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Introduction

Nearly all modern organizations rely extensively on computer-based information systems to process the data needed to operate their businesses for such tasks as managing employee data, keeping track of sales and inventory, engaging in product development, forecasting future demand, and maintaining customer information. When such information systems extend beyond the borders of one organization, and provide for automated information exchange to support linked business processes between two or more organizations, they are considered to be \textit{interorganizational information systems} (IOS) (Robey, Im, and Wareham 2008). IOS have become increasingly prevalent in the networked world in which businesses operate today. Often these systems are used to connect suppliers and manufacturers to support \textit{just-in-time} (JIT) inventory practices in \textit{supply chains} based on \textit{electronic document interchange} (EDI), a global standard for structured exchange of business data and documents. In the retail sector, \textit{collaborative planning, forecasting and replenishment} (CPFR) systems are used to improve coordination up and down the value chain of retailers’ supply partners, so that suppliers are better aware of consumer demand and retailers can better manage replenishment practices and
inventory costs. Moreover, electronic procurement has become pervasive in business-to-business (B2B) exchanges, promoting widespread use of IOS in nearly all types of industries.

The study of IOS has emerged as a distinct area within the broader field of information systems in large part due to the many challenges organizations face when they attempt to implement and use IOS (Markus 2006; Steinfield, Markus, and Wigand 2011). Since IOS by definition includes two or more organizations, decisions to adopt, implement, and use IOS are not independent decisions made by one firm, and can be influenced by a wide range of factors such as power differences between companies, the degree to which trading partners trust each other, or participants’ long term strategic goals (Robey, Im, and Wareham 2008). In contrast, the management of an internal information system is usually under the control of one organization, simplifying the processes of adoption, implementation, and use. IOS also face interoperability challenges, since the internal systems of the participating organizations may be based on incompatible and/or proprietary formats (Markus et al. 2006). This chapter provides an overview of the study of IOS, examining the basic types of IOS, implications for practice, and key research questions. An overarching theme of the chapter is that IOS are socio-technical systems, where the combination of technical choices, organizational practices, relational factors, and industry context all influence outcomes of IOS use.

**Types of IOS**

IOS as a distinct management concern and subject of study began to appear in the early 1980s, with researchers describing and categorizing interorganizational information sharing systems and their related management concerns (Barrett and Konsynski 1982; Cash and Konsynski 1985).
Early IOS were often simple remote ordering systems between trading partners in adjacent steps in a value chain (a manufacturer ordering parts from a supplier, a retailer ordering inventory from a manufacturer, or a travel agent reserving a seat for a client on an airline). More complex and higher-level systems involved more partners, additional business functions, and greater integration of business processes across separate trading partners (Barrett and Konsynski 1982).

Electronic Hierarchies and Electronic Markets

One early classification of IOS distinguished between systems connecting a buyer with a specific seller in a hierarchical relationship - termed an electronic hierarchy, and systems that connected buyers with a larger set of potential sellers - termed an electronic market (Malone, Yates, and Benjamin 1987). This distinction emphasizes two types of control that govern the behavior of the participants in the IOS. In the case of electronic hierarchies, there is an implication of longer term, stable business relations, where managerial and/or contractual relations will ensure that the potential for opportunistic behavior, such as providing substandard goods or services, is controlled. In electronic markets, however, market forces and exchange partners’ ease of switching to new trading partners provides the necessary governance over the behavior of participants in order to reduce the potential for opportunistic behavior (Malone, Yates, and Benjamin 1987).

Other types of IOS that do not fit so neatly in the electronic hierarchy-electronic market continuum are evident. For example, an ATM network like Cirrus, where the IOS is controlled by a network facilitator that is mainly in the IOS business, rather than set up by a company that is selling the core products and services carried by the network is another form of IOS arrangement
Choudhury (1997) further extends the electronic hierarchy-electronic market classification to account for the strategic relationships embodied in an IOS, describing three types of linkage patterns: 1) electronic monopolies – where buyers can only obtain a particular good through one seller’s IOS, 2) electronic dyads – where buyers establish separate electronic links with a number of different sellers, and 3) multi-lateral IOS, where buyers and sellers use a shared system for transactions that more closely correspond to spot market purchases.

**Horizontal, Vertical, and Cross Linkage IOS**

IOS can further be classified according to the industry structure aspects of relationships among the participants – horizontal, vertical, and cross linkages (Hong and Kim 1998). Those that link businesses that are in adjacent steps in a value chain - where each business progressively adds value to a product or service - can be thought of as vertical IOS. Vertical IOS are best exemplified in supply chain information systems linking suppliers to manufacturers and perhaps to distributors and retailers where the participants are in a dependent relationship with each other. Horizontal IOS link companies that operate at common stages of the value chain, where each company performs similar value adding activities. These are often found in more cooperative forms of business relationships such as alliances or partnerships. Cross IOS span vertical and horizontal dimensions linking both buyers with each other, as well as to sellers at different stages in the value chain (Hong and Kim 1998).

**Standards-Based vs. Proprietary IOS**

Recent work extends these earlier typologies by making three additional types of distinctions: 1) proprietary vs. standards-based IOS (Markus et al. 2006; Zhu et al. 2006; Nelson, Shaw, and
Qualls 2005), 2) point-to-point configurations vs. hub-based architectures linking participants in a supply chain, and 3) IOS systems that are closed and private vs. those that are shared and open to new participants (Steinfield, Markus, and Wigand 2011). The push toward standards-based IOS has been driven by the rapid expansion of the Internet and associated protocols such as XML into business data networks, making it easier for businesses to interconnect electronically with an ever-larger proportion of trading partners without the need for investment in new proprietary systems for each individual partner (Markus, Steinfield, and Wigand 2003). Over the past decade, data exchange standards have been developed in a number of different industries, often driven by trade associations and other voluntary industry consortia. Examples include RosettaNet in the electronics industry (Boh, Soh, and Yeo 2007), MISMO in the home mortgage industry (Markus et al. 2006), and ACORD in the insurance industry (Jain and Zhao 2003).

**Point-to-Point vs. Hub-Based IOS**

The distinction between point-to-point vs. hub-based systems has been used to shed light on the fundamental question of visibility in supply chains (Steinfield, Markus, and Wigand 2011). Lack of visibility in extended supply chains is associated with many information distortions faced by participants leading to such classic coordination problems as the bullwhip effect (Lee, Padmanabhan, and Whang 1997). Bullwhip effects occur when variations in orders propagate up the supply chain as each company builds in its own buffer inventory under conditions of uncertainty about actual demand, yielding larger and larger variations from actual sales data the further one goes up the chain. Since point-to-point systems only connect one supply participant to another, information about each transaction is not visible to other supply participants, even though they may benefit from having such information. Imagine the situation, for example,
when a lower tier supplier experiences a delay in shipping crucial parts to a higher tier assembler. This will in turn impact the availability of completed assemblies to the manufacturer, but if information only flows through separate point-to-point systems, the manufacturer may not be made aware of the delay until later, when it may be too late to adjust production schedules. If the supply chain participants were involved in a hub-based system with appropriate business rules for sharing information about supply chain events, then the manufacturer would know about the delay immediately and can plan accordingly. Such an approach is under development in the automotive industry. This approach, known as the Materials Off-Shore Sourcing standard, is designed as a hub-based system where shipment information is simultaneously made available to the relevant participants as soon as events occur (Steinfield, Markus, and Wigand 2011). More broadly, hub-based approaches can support greater collaboration among supply chain participants, as opposed to primarily providing transaction support (Markus and Christiaanse 2003).

Open and Shared vs. Private IOS Hubs

A final distinction is whether IOS systems are shared and open to new participants or are private and limited to a specific set of invited participants (Christiaanse 2005; Markus 2006; Steinfield, Markus, and Wigand 2011). Shared hubs generally are structured as business-to-business electronic marketplaces, providing the ability to support vertical exchanges among supply chain participants, but incorporating competing companies and their partners as well. Such an arrangement is different from a private hub, which may or may not be standards-based, but is driven by a dominant player that only includes its own trading partners. This arrangement is often associated with dedicated supply chains, where a dominant manufacturer or retailer works
with a specific set of suppliers who do not do business with other buyers. In many industries, however, supply chains are *interconnected*, such that a supplier does business with multiple buyers who compete with each other. A private hub managed by only one buyer would therefore only accommodate a portion of such a supplier’s transactions, requiring additional investment in duplicate systems and processes to support exchanges with other trading partners (Steinfield, Markus, and Wigand 2011).

The various combinations of IOS business functions, ownership and governance structures, and technological choices have implications for the extent to which IOS are adopted and implemented, as well as for the kinds of outcomes participants experience. For example, EDI-based IOS often lack participation by small and medium-sized enterprises (SMEs) who face challenges implementing EDI due to a lack of requisite knowledge, limited resources, and fewer anticipated benefits due to their generally lower volume of transactions (Markus 2006; Segev, Porra, and Roldan 1997; Iacovou, Benbasat, and Dexter 1995). When forced to use EDI by larger and more powerful trading partners, SMEs may implement the system only superficially to satisfy partner requirements, which limits the overall integration and coordination benefits that such systems offer (Hart and Saunders 1997). Even the supposedly lower cost Web-based EDI approaches have not led to widespread EDI adoption by SMEs (Beck and Weitzel 2005). On the other hand, developing standards-based IOS and implementing these in shared coordination hubs can also be difficult because competing companies view the systems they use to exchange data with partners as strategic tools that convey competitive advantage, and are therefore prone to pursuing proprietary approaches (E. K. Clemons and Row 1988; Mukhopadhyay and Kekre 2002; Young, Carr, and Kelly 1999). Additionally, vendors of IT products and services are also
reluctant to develop standards-based systems for their clients, since this would presumably make it easier for their clients to switch to new vendors’ products (Markus et al. 2006).

**Impact on Practice**

There are many well-established cases where companies initiating IOS connections with their trading partners have experienced such benefits as reduced costs of transactions, fewer errors with orders and delivery, greater efficiency due to the reduced need to rekey information into separate systems, and enhanced competitiveness. Examples include McKesson in the wholesale pharmaceutical supply industry (E. K. Clemons and Row 1988), Baxter in the medical supply industry (Short and Venkatraman 1992), Chrysler (Mukhopadhyay, Kekre, and Kalathur 1995), Federal Express (Williams and Frolick 2001), Intel (Cartwright et al. 2005; Markus 2006), Japan Airlines (Chatfield and Bjorn-Andersen 1997), and Sabre in the airline reservation industry (Christiaanse and Venkatraman 2002).

Many of the cases cited above represent proprietary efforts implemented by a dominant trading partner for the purposes of improving its competitive position. One of the earliest and most heavily cited examples is the well-known case of McKesson’s Economost system, introduced in the late 1970s and early 1980s. McKesson, a drug wholesaler, used its system to provide advanced electronic ordering and inventory management services to independent pharmacies that otherwise had little in the way of automated systems. Hand held terminals, communications lines, and a series of business applications were provided to client pharmacies. The system reduced transaction costs, improved inventory practices, solidified McKesson’s role as the distributor for these drug retailers, and improved the ability of independent pharmacies to
compete against national drugstore chains (E. K. Clemons and Row 1988).

The retail sector has also experimented with many IOS approaches, primarily aimed at reducing the proportion of inventory holdings that are safety stock – i.e. extra inventory held to protect a company from the negative effects of delayed shipments. Large retailers such as WalMart, as well as consumer products manufacturers like Proctor and Gamble, have experienced significant savings due to such IOS efforts as Vendor Managed Inventory (VMI), Efficient Consumer Response (ECR), and more recently, Collaborative Planning, Forecasting, and Replenishment (CPFR) systems (Fliedner 2003). Essentially, these systems strive to support the sharing of retailers’ point-of-sale (POS) data with partners further upstream in the retail channel, including wholesalers, manufacturers, and suppliers. POS data provides information about consumer demand, enabling each partner in the channel to adjust inventory stock based on real time information, and speed up ordering and replenishment processes. Despite the efforts of the Voluntary Interindustry Commerce Solutions Association (VICS), an association of retailers and manufacturers, CPFR is not a fully standardized solution. Rather, it is largely limited to specific manufacturer-retailer chains where a strong participant drives implementation among its partners in the channel (Markus and Gelinas 2006).

Cartwright and colleagues (Cartwright et al. 2005) detail the benefits that Intel has received due to its implementation of an IOS based on RosettaNet standards, enabling electronic connections with its many suppliers around the world. They report that by re-architecting its IT infrastructure around RosettaNet standards, Intel saved as much as $40 million in 2004 alone due to increased process automation and a greater ability to create value through outsourcing to third party
logistics providers. This case study also revealed an important benefit that follows from such an aggressive implementation of standards-based IOS – it supported greater integration of business processes across the many disparate information systems *inside* the company. Nonetheless, many of the smaller business partners were unable to bear the costs of converting to RosettaNet standards, precluding Intel from mandating its use. This necessitated the maintenance of a range of information exchange options within Intel’s supply chain, including RosettaNet, EDI, Internet-based file transfer protocol (FTP) and Web-based transactions (Steinfield, Markus, and Wigand 2011).

Industry-wide information system standards can help address the issue of the need to re-invest in duplicative IOS to do business with multiple trading partners, and can enable SME participation particularly when standards are designed around lower cost Internet protocols such as XML and *service oriented architectures* (SOA) (Boh, Soh, and Teo 2007; Löhe and Legner 2010; Steinfield, Markus, and Wigand 2005; Venkatesh and Bala 2012; Wigand, Steinfield, and Markus 2005). SOA refers to a new approach to IOIS that capitalizes on the Internet’s wide reach by using standardized web-based services that work across applications (Löhe and Legner 2010). This allows organizations to have more easily reconfigurable IOS so that new connections and disconnections from trading partners can be more easily accommodated (Löhe and Legner 2010).

For example, XML-based standards for various transactions were developed in the home mortgage industry led by the Mortgage Bankers Association and its subsidiary, the Mortgage Industry Standards Maintenance Organization (MISMO). The availability of such industry-wide
or *vertical information system* (VIS) standards has contributed to performance improvements over the industry as a whole, providing significant reductions in the total costs across the value chain for processing mortgage applications as well as the time from application to closing (Steinfield, Markus, and Wigand 2005). Moreover, there is further evidence that MISMO standards have contributed to vertical disintegration in the mortgage industry, allowing companies to outsource various mortgage processing functions to SMEs as a result of the reduced coordination costs made possible by VIS (Wigand, Steinfield, and Markus 2005).

XML-based standards also figured heavily in RosettaNet, which not only helped to lower the costs and time for developing standards, but also enabled participation by the growing number of Asian suppliers to the electronics industry (Boh, Soh, and Yeo 2007). More recently, Internet-based standards such as XML implemented into an SOA are forming the basis for interorganizational business process standards (IBPS) (Venkatesh and Bala 2012). IBPS specify shared and agreed upon “interrelated, sequential tasks and business documents” to enable greater integration among business partners (Venkatesh and Bala 2012).

Not all IOS efforts have been successful. For example, Steinfield and colleagues (Steinfield, Markus, and Wigand 2011) review the history of problematic efforts by one automotive manufacturer to implement proprietary IOS throughout its supply chain. Automotive industry supply chains are characterized by multiple tiers of suppliers, and while there are extensive EDI linkages between top tier suppliers and manufacturers, IOS connections to lower tier suppliers are less common due to their lack of technical expertise and other resources. Moreover, many lower tier suppliers in the automotive industry do business with multiple manufacturers, making
the supply chains interconnected rather than dedicated. Hence, it has been difficult to extend proprietary IOS throughout the supply chain. The lack of interoperable IOS throughout the automotive supply chain imposes significant costs to the industry as a whole. A 2004 study by the National Institute of Standards and Technology (NIST), for example, found that inadequate use of IOS in the automotive supply chain cost the industry more than $5 billion due to errors, delayed shipments, and inadequate or excess inventory holdings (White et al. 2004). Despite the considerable cost savings that have been found to result from EDI use between automobile manufacturers and their suppliers (Mukhopadhyay, Kekre, and Kalathur 1995), the lack of full implementation across the entire supply chain remains a consistent problem.

In summary, there are many well-known cases where use of IOS has contributed to lower costs, greater efficiency, increased business, competitive advantage, and broader performance benefits at the industry level. However, IOS adoption is far from universal, and examples of failed implementations are also evident. Hence, research has investigated the factors associated with successful IOS development, adoption, and implementation, including the identification of both anticipated and unanticipated outcomes of use. An overview of research issues is provided in the next section.

**Research Issues**

IOS research can be broadly grouped into studies of IOS adoption, diffusion and implementation, IOS outcomes, and IOS development and governance. A common theme across much of the IOS research is that while the technical aspects of IOS – often called the information system artifact (Benbasat and Zmud 2003; Orlikowski and Iacono 2001) – are important, IOS should be viewed
as *socio-technical systems* in order to understand how such systems are developed, adopted, implemented and used, and impact organizations and industries. That is, the social, organizational, and industry contexts in which IOS are embedded must be examined in concert with IOS technical features in order to understand the varying outcomes surrounding systems that contain seemingly equivalent technical features. Indeed, a recent meta-analysis of the EDI literature highlighted the inconsistent findings regarding factors influencing EDI adoption and benefits, positing such factors as industry influence and anticipated benefits as mediating forces that affect the relationship between hypothesized predictors of both adoption and benefit (Narayanan, Marucheck, and Handfield 2009).

**IOS adoption and implementation**

Why do some organizations adopt IOS such as EDI, while others do not, despite the potential benefits they can obtain? Much of the past research has focused on EDI adoption, highlighting a number of antecedents that can be broadly grouped into internal and external factors. Internal factors found to influence adoption decisions include a variety of characteristics of the adopting organization that broadly reflect its *readiness* for IOS. These include having the requisite human, financial, and technical resources needed for implementation, compatible legacy systems, and business processes that have been improved to take advantage of IOS capabilities (Chau and Hui 2001; Iacovou, Benbasat, and Dexter 1995; Markus and Christiaanse 2003; Premkumar and Ramamurthy 1995; Narayanan, Marucheck, and Handfield 2009). External factors generally include aspects of the relationships between an adopting organization and its trading partners. Research has examined the extent of trust and the nature of dependencies among participants, whether there are power differences that might lead to coercion or other pressures to adopt, and
the effect of incentives (e.g. promises of increased business) by a dominant partner as predictors of adoption (Chwelos, Benbasat, and Dexter 2001; Hart and Saunders 1997; Hart 1998; Kumar and van Dissel 1996; Kumar, van Dissel, and Bielli 1998; Riggins and Mukhopadhyay 1999; Teo, Wei, and Benbasat 2003).

As noted earlier, often EDI adoption by SMEs has historically been limited, which is not surprising as SMEs tend to have more limited financial resources, and can lack sufficient managerial and technical expertise needed to implement EDI. Hence, one research issue for IOS adoption researchers is how to increase adoption rates among SMEs. One approach is for the larger, more powerful trading partner to simply mandate adoption in order to do business with it; however, research has demonstrated that such attempts at coercion often do not succeed and generate resistance among smaller trading partners (Hart and Saunders 1997; Steinfield, Markus, and Wigand 2011). SMEs may not refuse adoption altogether, but may adopt IOS technologies in a superficial manner, e.g. for a limited set of transactions, depriving the partners of potential efficiencies or strategic benefits as a result (Massetti and Zmud 1996). To facilitate adoption, the IOS may be subsidized, or offered at no cost to smaller trading partners (Riggins and Mukhopadhyay 1999). Yet, even when entirely provided by the dominant partner, such systems still impose costs related to learning and the need to maintain redundant systems if the dependent partner does business with other organizations that use a different IOS. To insure that partners do engage in such relationship-specific investments, there must be sufficient expectation of future business (Mukhopadhyay and Kekre 2002). Indeed, in one study of IOS use in four industries, electronic transactions with smaller suppliers of key inputs were more common in situations where there were quite strong ties – in some cases extending to ownership ties –
between trading partners (Kraut et al. 1999). More broadly, the imposition of costs for adopting and implementing IOS has to be perceived as equitable, and the benefits have to be shared, in order to encourage greater adoption (Jap 1999).

**IOS Outcomes**

The outcomes of IOS adoption and use have also received a great deal of attention in the literature (Narayanan, Marucheck, and Handfield 2009; Robey, Im, and Wareham 2008). In general, research has explored both tactical and strategic impacts of IOS use (Chatfield and Yetton 2000). Successful IOS use can result in many types of tactical benefits, ranging from reduced lead time for orders, faster deliveries, fewer errors in procurement transactions, fewer out-of-stock situations, reductions in the size of inventory holdings, increased staff efficiency, better monitoring of shipments, lower costs, and other transactional and operational benefits (Narayanan, Marucheck, and Handfield 2009). Research on strategic benefits emphasizes competitive advantage outcomes such as growth in the volume of business with existing or new trading partners, improved relationships with trading partners leading to better communication and information sharing, improved market share, faster product design cycle times, and higher quality of products and services (Chatfield and Yetton 2000; Narayanan, Marucheck, and Handfield 2009; Riggins and Mukhopadhyay 1994).

Not all implementations of IOS realize the benefits anticipated by their initiators, however. Research suggests that any benefits of IOS use, especially strategic ones, are mediated by the breadth and depth of adoption and the extent to which IOS use is integrated into an organization’s business processes (Massetti and Zmud 1996; Narayanan, Marucheck, and
Handfield 2009). Massetti and Zmud (1996) identify four facets of EDI adoption, for example, that signify the intensity with which it has been integrated into business processes: 1) *volume* is the overall extent to which a company’s transactions are carried out over EDI, 2) *diversity* measures the range of different types of transactions handled by EDI, 3) *breadth* refers to the extent to which EDI is used with each of a company’s trading partners, and 4) *depth* refers to the extent to which EDI has been integrated into the business processes of a company and a particular trading partner. Furthermore, business processes may need to be re-engineered to take advantage of IOS capabilities, rather than simply automating existing processes in order to realize benefits (Clark and Stoddard 1996). Just-in-time inventory practices can be enabled with IOS, but only if new business processes by suppliers and manufacturers are developed that support new channel distribution practices such as continuous replenishment. *Business process re-engineering* can also help companies integrate across disparate legacy systems, such that enhanced internal efficiencies result from IOS use (Markus 2006).

In order to achieve high value strategic benefits with more tightly-coupled business processes over IOS, companies have to be willing to share proprietary information with each other. Because of the sensitive nature of the data that is shared, including design data, forecast data, operational data and more, there can be understandable reluctance to participate in such highly integrated IOS without a strong degree of trust between partners (Hart and Saunders 1997; Hart 1998). Hence, an ongoing thrust in the IOS research literature explores the nature of the relationships between IOS participants, and the influence of these relationships on outcomes of IOS use. Essentially, this research takes as a starting point that economic exchange can be facilitated by personal relationships among participants – trust and the social obligations that
follow from being embedded in a network of relationships mitigate opportunistic behavior of participants and encourage reciprocation and cooperative exchange (Granovetter 1985; Kumar, van Dissel, and Bielli 1998; Uzzi 1997). EDI researchers have further shown that when systems exhibit such embeddedness – fostering tight integration among trading partners characterized by high trust – the participants are more likely to experience the kinds of strategic benefits that yield competitive advantage (Chatfield and Yetton 2000).

These findings expose an interesting theoretical tension in IOS research, and reveal how IOS use can lead to impacts at higher levels of analysis such as on market structure, supply chains and whole industries. On the one hand, there is strong evidence inspired by transaction cost economic theory that increased use of IOS facilitates a “move to the market” encouraging companies to use networks to acquire needed inputs from the lowest cost suppliers that satisfy requirements (Alt and Klein 2011). This is occurring because IOS networks reduce the traditional transaction costs associated with market exchanges; they lower search costs and make it easier to monitor transactions (Malone, Yates, and Benjamin 1987). On the other hand, achieving strategic benefits seems to require tighter integration that is not consistent with arms-length, market transactions (Chatfield and Yetton 2000; Kraut et al. 1999). More research is needed to resolve this paradox, but one explanation may be that companies are more willing to use electronic market transactions for commodity inputs that are not highly asset specific (i.e. they are not tailored to a particular company’s needs). Conversely, they rely on tighter connections to a smaller set of suppliers for core inputs with greater asset specificity and a higher degree of proprietary information sharing. Such an arrangement with core suppliers reflects what has been called a “move to the middle” approach, representing a structure in between
hierarchies and markets (E. Clemons, Reddi, and Row 1993).

Research on the impacts of IOS use at higher levels of analysis beyond the dyad is less common, despite several calls for more attention to the industry structure implications of IT-enabled interorganizational exchanges (Gregor and Johnston 2001; Johnston and Gregor 2000; Segars and Grover 1995; Steinfeld, Markus, and Wigand 2005; Wigand, Steinfeld, and Markus 2005). Segars and Johnston (1995) studied the effects of IOS on three industries: 1) airlines and computer-based reservation systems, 2) the chemical industry’s use of EDI, and 3) the pharmaceutical industry and EDI, finding structural influences such as greater consolidation in all three industries. The degree of structural change was a function of the ease with which competitors could imitate an IOS initiator’s innovation; where easily imitated, IOS use proliferated rapidly throughout the industry. Johnston and Gregor (2000) develop a theory of industry level impacts of IOS, emphasizing the need to look at higher level factors such as the role of industry groups, government policy makers, and competitive dynamics in order to understand how IOS adoption and use occurs in different industries. These higher level factors also are viewed as necessary for understanding how IOS use affects both routine business practices as well as the relationships among actors in the industry.

The availability and widespread acceptance of vertical information system (VIS) standards is another important factor in understanding industry-level impacts of IOS. Due to the rise of lower cost data exchange protocols made possible by the growing use of Internet-based XML, many industries formed user-led associations with the purpose of establishing VIS standards (Markus et al. 2006). If successful, such efforts have the potential to include SMEs as participants in IOS
for a number of reasons. First, if Internet and XML-based, they can be less costly and less complex. Second, participating in systems built on open standards should presumably make it easier to connect with other trading partners, generating network externalities (benefits derived from the greater numbers of other users that are accessible in a network) that increase the attractiveness of using a standardized IOS (Zhu et al. 2006). In the home mortgage industry, for example, widespread usage of VIS standards resulted in significant industry performance benefits due to the aggregation of gains in efficiency among participating organizations (Steinfield, Markus, and Wigand 2005). Structural changes in the mortgage industry were also observed, including evidence of consolidation among the larger players as well as growth in the number of smaller players who used VIS-based systems to fill specialty niches in the industry (Steinfield, Markus, and Wigand 2005; Wigand, Steinfield, and Markus 2005).

**IOS Development and Governance**

Research on IOS development and governance can be vital to understanding the prospects for IOS adoption and use. IOS governance broadly refers to how decisions regarding IOS systems development and usage are made, and how individual and organizational action is coordinated vis-à-vis the IOS (Markus and Bui 2012). This can include decisions regarding who participates in the IOS, how any technical changes to the IOS or its configuration are determined, for what transactions the IOS will be used, and who owns any intellectual property rights associated with the IOS.

A recent focus of IOS development research has investigated the process through which industry consortia develop VIS standards (Boh, Soh, and Yeo 2007; Markus et al. 2006). Markus and
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... colleagues (2006) conceptualize this process as a *collective action* problem. Such problems refer to situations where a group effort is required to achieve a collective good, but such goods have the characteristics of *public goods*, where *free riding* can occur. That is, participants who have not necessarily contributed to the production of the good can still enjoy its benefits, and therefore may have a disincentive to help shoulder the associated costs of production. VIS standards are public goods; organizations do not have to contribute to their development, but nonetheless benefit from their existence if they achieve widespread adoption. Markus et al (2006) highlight the types of collective action dilemmas that need to be resolved in order for industry consortia to be able to effectively develop standards that have a greater probability of achieving widespread adoption. They point out that standards development and standards diffusion are two linked collective action problems, and it is possible to solve the former in such a way that the latter is less likely. For example, if the consortia privileges only certain types of participants (e.g. large companies, or those from only one segment of an industry) and not others, then there is a greater chance that whatever standard is developed will not adequately address the needs of those who did not participate in the standards development process. This can lead to an industry standard that is not taken up by the under-represented companies, and hence fails to achieve widespread adoption, depriving all industry participants of potential benefits. Their case study of the home mortgage industry identifies the diverse interests of different types of industry stakeholders – and particularly emphasizes the different needs of IT vendors vs. IOS users. Bringing IT vendors into the process, even in user-driven consortia, is essential so that the software solutions available to industry participants will be standards-based. This is especially important for SMEs that are not likely to develop their own IOS. Hence, involvement in the development of the standard by all segments of the industry was a crucial strategy undertaken by the Mortgage Industry Standards
Maintenance Organization in order to ensure that the outcome was palatable across the key stakeholder groups.

A variety of governance issues come to the fore when IOS standards are examined in this light. For example, standards consortia must deal a priori with intellectual property issues, so that when a standard is developed, adopting companies are not obligated to pay unexpected licensing fees or royalties to participants that had not revealed ownership or granted royalty free use of patents that were used (Steinfield et al. 2007). Processes for ensuring compliance with standards must be in place to avoid the problem of fragmentation of the standard, which can occur when there is some leeway in implementing the standard and individual vendors and other organizations make small changes that cause one version of the IOS to be incompatible with another (Damsgaard and Truex 2000). Other direct governance issues related to the function of standards consortia include rules for who can participate in the work of the committees developing the standards, as well as voting rules for selection of officers and for making other decisions (Markus, Steinfield, and Wigand 2003). All of these factors can shape the development process in ways that not only influence IOS standards development, but also the prospects for diffusion throughout the industry. Standards that are largely driven by dominant companies and which fail to take into account the needs of other industry participants are less likely to experience successful diffusion.

Not all governance issues are about standards development. As noted earlier, some IOS are hub-based, and interconnect many different trading partners in a common system. A recent study by Markus and Bui (2012) identifies the governance challenges faced by what they call
**interorganizational coordination hubs** (ICHs). ICHs face such challenges as attracting adequate investment, ensuring participation, and determining rules related to ownership and access to the data they generate (Markus and Bui 2012). In one study of an ICH developed for an automotive supply chain, the participants opted for a third-party owned IOS to avoid perceptions that the system would only cater to the needs of the dominant manufacturer that functioned as the buyer in the supply chain (Steinfeld, Markus, and Wigand 2011). Moreover, they encouraged participation by allocating costs for the system according to the extent to which participants benefit from its use; in this case since the buyer benefited the most, they absorbed the lion’s share of the costs.

**Towards a Research Agenda**

The previous sections have highlighted a number of significant research questions related to IOS adoption and implementation, IOS outcomes, and IOS development and governance, and offer insights into the key directions for research on IOS in the next several years. In the area of IOS adoption and implementation, there is clearly a need for more research that clarifies how organizations, and particularly SMEs, evaluate the risks and rewards of participating in an IOS. How can industry associations help to diffuse the IOS standards they have developed more effectively, and encourage companies in their industry to adopt them? What approaches can companies take to increase trust and convince smaller trading partners to sign on to use IOS?

In the area of IOS outcomes, more research is needed to better understand why some IOS participants benefit while others do not. What IOS arrangements best contribute to improved outcomes for all participants? How can IOS be structured so that there is both a reliance on
standards to keep costs down, but also ample opportunity for companies to employ IOS strategically in ways that are difficult for competitors to imitate?

IOS development and governance research in the coming years will be critical for understanding the questions posed above. For example, research on how to attract more SMEs to participate in VIS standards-making will be essential for solving diffusion and adoption problems. With more representative participation, there should be a better match between SME needs and the types of standards that are developed. Moreover, awareness of the availability and utility of standards should be greater and SME involvement in the process may motivate later adoption and use. Research on governance of IOS will be essential as well. With the growth of shared coordination hubs, more research is needed to understand if such shared IOS platforms based on open standards are more likely to find acceptance, or if companies will resist due to perceptions of a loss of control and competitive advantage? Clearly, much work remains to be done over the coming years to provide guidance to IS managers and to IT vendors so that the potential benefits of IOS can be more effectively harnessed.

Summary

This chapter has provided a broad introduction to the field of interorganizational information systems. Modern organizations of all types – public and private, profit and non-profit, large and small – need to rely on IOS to reduce costs, improve quality of products and services, and compete effectively. Implementing IOS, however, is not an independent decision of a single organization, and requires cooperation among the participants in order to achieve desired outcomes.
An overview of the many different types of IOS was provided, ranging from dyadic systems that link a pair of organizations for computer-based transactions to interorganizational coordination hubs that can interconnect and support transactions among a supply chain or even an entire industry. Further distinctions between proprietary vs. standards-based IOS were described.

The successful use of IOS has had significant impacts in many industries, and is associated with such far-reaching innovations as just-in-time inventory management practices and the advent of computerized reservation systems. However, success is not guaranteed, and there are many instances where organizations have attempted to implement IOS only to find that partners resist adoption or adopt in ways that limit overall benefits to the various stakeholders. SME adoption of IOS technologies such as EDI in particular has been problematic.

As detailed in this chapter, research has investigated the factors that influence IOS adoption and use, as well as the outcomes that organizations experience from their use of IOS. Such factors as having requisite technical competence, financial resources, and experience with existing internal systems reflect a readiness for IOS that can enhance prospects for adoption. In addition, the review has revealed the importance of trust among IOS participants, anticipated benefits, and the role of incentives in spurring IOS adoption. The research on IOS outcomes detailed in the chapter identifies two broad types of benefits that participants can experience with successful use of IOS: operational benefits that largely result from the ability to engage in more efficient transactions, and strategic benefits related to IOS users’ relationships with their partners and users’ competitive positions in their industry. IOS impacts can be far-reaching, and research has
also identified ways in which IOS use can influence entire industries by improving performance and altering the industry structure.

Finally, the study of IOS development and governance was introduced as an important area of research. Questions such as how and why some industries have been able to successfully develop industry-wide IOS standards while others have failed represent new areas of research that have significant societal and economic implications. As reliance on IOS becomes ever more pervasive, research is needed to more fully understand and solve the governance challenges raised by emerging IOS configurations such as shared coordination hubs. Advances in technology are creating many new opportunities, but the benefits can only be realized when the business and organizational context of IOS use is taken into account.

**Defining Terms**

Asset specificity. When goods or services in a transaction are of value only to a particular recipient and cannot be sold as is to other potential buyers, they are considered highly specific assets. In general, when needed inputs exhibit strong asset specificity, transaction cost theory suggests that organizations will seek to produce in house (i.e. use hierarchy as governance) to protect themselves from threats of opportunism.

Bullwhip effect. Bullwhip effects occur when variations in orders propagate up the supply chain as each company builds in its own buffer inventory under conditions of uncertainty about actual demand, yielding larger and larger variations from actual sales data the further one goes up the chain.
Business process re-engineering. The process of redesigning work flows to improve business performance, often motivated by the desire to take advantage of new capabilities made possible by new information systems.

Collective action. The set of behaviors by a group of individuals or organizations as they work to achieve a common goal or objective.

Collaborative Planning, Forecasting, and Replenishment (CPFR). A set of guidelines promoted by the Voluntary Interindustry Commerce Standards (VICS) Association to facilitate the cooperative management of inventory by sharing data on customer demand as well as production and distribution across a supply chain.

Efficient Consumer Response (ECR). An approach to achieving more timely inventory practices by linking replenishment to actual consumer demand rather than by having retailers make orders based on periodic forecasts.

Electronic data (or document) interchange (EDI). The structured transmission of computerized messages between organizations to support the electronic exchange of standard business documents such as purchase orders or bills of lading. EDI message standards have been developed globally by the International Standards Organization (ISO), as well as by national standards bodies and many different industry associations.
Electronic hierarchy. A type of relationship between two organizations that are connected by an IOS where the two company’s business processes are tightly integrated and governed by management control as opposed to market forces.

Electronic market. A form of electronic interconnection among groups of organizations where the actions of the participants are controlled by market forces, enabling companies to engage in transactions with a number of different partners due to the reduced costs of coordination afforded by computer-based networks.

Free riding. Allowing others to bear the costs of producing a collective good while enjoying the benefits of the good.

Governance. In the context of an IOS, governance refers to how decisions regarding IOS systems development and usage are made, and how individual and organizational action is coordinated.

Interconnected vs. dedicated supply chains. Interconnected supply chains are those in which suppliers provide goods and services to multiple buyers, while in dedicated supply chains, a supplier typically only sells its output to a single buyer.

Just-in-time inventory practices. An inventory management approach that minimizes inventory holding costs making more frequent deliveries of supplies as close as possible to the time when they are needed based on real time information about stock levels.
Network externality. A benefit from using a good or service that is a function of the number of others that are also using the same good or service, and which is not necessarily captured in the price. An example is the benefit of having more potential trading partners in an IOS that has a larger number of participants, even though each user does not pay more when a new participant joins.

Public good. Such goods are types of goods that have the attributes of being non-rivalrous and non-excludable. Non-rivalrous means that one person’s (or organization’s) use of the good does not diminish its supply or prevent others from using it. Non-excludable means that it is not possible to prevent others from using the good once it is produced. A public/open IOS standard is often thought of as a public good, since those who did not contribute to its development can still use it.

Service-oriented architecture (SOA). An emerging approach to information system design utilizing Web services accessible through the Internet that makes it easier to re-use software components across applications. Such architectures make IOS more dynamic and reconfigurable.

Supply chain visibility. Supply chain visibility refers to the ability to track goods and related supply chain events from the point of production to the delivery at the end-user’s premises.

Vertical information system (VIS) standards. These are a set of data definitions and electronic
transaction standards that are focused on the unique needs, products, and services relevant to the value chain of a specific industry. VIS standards have been developed in many industries such as the mortgage industry, insurance industry, automotive industry, and so forth.

References


Further Information