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Interorganizational Systems and Embedded Relationships:

A Resource Dependency Perspective of Interorganizational Systems Management[1]

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Abstract

This paper adopts a resource dependency perspective to demonstrate the premise that interorganizational systems (IOS) are not all created equal, but are all related in such a way that influences their manageability and conduciveness to change. This principle is theoretically established and empirically supported through a comprehensive review of the IOS literature. Associations between four base IOS types - reciprocal-sequential, modular-sequential, modular-pooled, and reciprocal-pooled - are established. The relationships are represented as a series of propositions that together define an embedded resource dependency theory of IOS management. This theory is then used to provide a new perspective on two long-standing questions: whether technology-specific IOS research represent conceptually distinct fields of study, and why eHierarchies and eMarkets do not develop entirely as predicted. The paper concludes with a discussion of future research opportunities, such as the effects of the type of IOS relationship on an important organizational capability, the ability of network members to adopt new technology.

Keywords

Interorganizational Systems, Task Interdependency, Organizational Strategy, General Management, Global Information Systems

Introduction

As advances in information and communication technology (ICT) such as the Internet have accumulated, organizations have leveraged them to collaborate through hybrid organizational forms such as integrated supply chains, e-Markets, joint product design efforts, and strategic alliances (Kumar & van Dissel 1996; Malone et al. 1987). Each of these examples represents a fundamentally different form of inter-firm relationship involving correspondingly different management challenges and issues (Choudhury 1997; Das & Teng 2001, 2002b), few of which are fully understood in the interorganizational context (Holland & Lockett 1997). As advances in ICT continue, and as organizations gain more experience in using them, technology's role in supporting inter-firm relationships is expected to increase. Some have suggested, however, that the technology, as it becomes more capable and prevalent, is becoming less and less a source of competitive advantage. Sustainable competitive advantage is most likely achieved through the management of the technology and the relationships that it engenders (Mata et al. 1995). Accordingly, the necessity to understand ICT-based inter-firm relationships, how they are related, and their unique management challenges, is also increasing (Choudhury 1997; Kumar & Crook 1999). The ICT structures that are used to enable interorganizational forms are more commonly referred to as interorganizational systems.

Interorganizational systems (IOS) are defined as information and communication technology-based systems that extend beyond an organization's legal boundaries and link otherwise independent organizations together (Cash & Konsynski 1985; Kumar & van Dissel 1996). IOSs enable the development of stronger inter-firm relationships and higher degrees of interconnectedness through the boundary-spanning nature of the technology (Kumar & van Dissel 1996). The airline, financial, retail, manufacturing, government, and health-care industries, among others, are increasingly using IOSs to structure, create, and operate collaborative relationships (Kumar & Crook 1999; Massetti & Zmud 1996; Payton 2000). Managing collaborative IOS relationships requires practices that differ not only from those used within a single organization, but depend on the type of IOS relationship as well (Das & Rahman 2002; Kumar & van Dissel 1996).

The premise of this paper is that different IOS types are not created equal, but they are all related in such a way that influences their manageability and conduciveness to change. By 'manageability' we refer to the number of distinct organizational issues, such as resolving stakeholder differences, that are likely to be involved in managing a firm's participation in an IOS, where the greater the number of distinct issues, the greater the management intensity required to deal with them (as measured by time and effort). To effectively manage participation in an IOS requires an understanding of the different types of relationships embedded in different forms of collaboration. Past research acknowledges that different IOS types exist, but does not necessarily agree on what they are, how they differ, or why (Holland & Lockett 1997; Kumar & van Dissel 1996; Kumar & Crook 1999). In the absence of a strong theory-based typology, new IOS instances tend to be reported as one-offs (Raghunathan 1999) or as separate streams of research (Iacovou et al. 1995; Vlosky et al. 1994), creating a barrier to cross-informing or building a cumulative research tradition. While notable exceptions do exist (Kumar & van Dissel 1996), the majority of IOS typology research is based on empirical generalizations (Cash & Konsynski 1985; Choudhury 1997; Johnston & Vitale 1988; Malone et al. 1987). The development of a theoretically grounded taxonomy is regarded as a necessary first step in building a cumulative body of research (Grover & Goslar 1993; Wilson 1994). Recent calls for research (Holland & Lockett 1997; Kumar & Crook 1999) indicate a requirement to examine IOS relationships and management techniques through theoretical perspectives linking IOS types to management practice. The first step toward this goal is the establishment of a clear classification of IOS relationship types, and then relating those types to reported management challenges associated with them.

The purpose of this paper is to explain how and why different IOS environments are differentiated by the nature of the inter-firm relationships involved, and to explain the management challenges associated with each type. In doing so, we move the management of IOS practice away from the management of the technology and toward the management of the technology-enabled relationship.

Three contributions are made to the study IOS management. First, we create a typology capable of discriminating and comparing IOS instances in practice, which is then used as a theoretical lens to illustrate and explain the specific management challenges to be aware of when considering or dealing with each type. As a third contribution we offer a new perspective on two long-standing questions in Management Information Systems research, questions regarding electronic hierarchies versus electronic markets as well as the distinctiveness of different IOS networks, such as EDI versus Internet-enabled business relationships. By providing a new perspective we hope to stimulate new thinking in this area that may lead to interesting and valuable new directions for the field.

This analysis is beneficial for both practical and theoretical reasons. From a practical standpoint, outlining the specific management challenges in different IOS types is beneficial for managers seeking guidance in employing best practices or benchmarking. Understanding how different IOS experiences are actually quite similar allows for informed comparisons between prior IOS examples that appear similar in some regards but have radically different outcomes. In addition, linking specific management challenges to specific IOS types benefits practice by providing a list of 'watch-points' to be aware of in advance. From a theoretical perspective, a grounded typology of IOS relationships is required to differentiate the literature along theoretical lines. In addition, the separation of IOS technology from the IOS relationship acknowledges that ICTs are associated with, but do not define, the type of IOS. For example, while electronic data interchange (EDI) is strongly associated with supplier-buyer relationships (Nidumolu 1995), not all supplier-buyer relationships involve EDI (Narayandas et al. 2002), and EDI can be used in relationships outside the buyer-supplier typology (Au & Kauffman 2001). A supplier-buyer relationship, however, defines a particular form of IOS regardless of the technology involved.

The paper proceeds as follows. After defining key concepts, existing IOS classification schemes are considered as a starting point for the development of an embedded resource dependency based framework. The IOS management literature is then reviewed and differentiated by two types of inter-firm relationship dependency variables: the degree of co-dependency and the degree of interconnectedness between partners (Pfeffer & Salancik 1978). A discussion of the results and the development of an embedded resource dependency IOS management theory precede a brief conclusion. Proposals for exciting opportunities for future research complete the paper.

Literature Review

The IOS literature spans several disciplines, most notably those of Information Systems, Marketing, Organizational Behavior, and Operations / Supply Chain Management. The key concepts in this literature are interorganizational systems, information and communication technology, inter-firm relationships, and network effects. Following definitions of these terms, previous IOS typologies are reviewed and an analysis framework is developed. This section ends with a short explanation of the review framework for IOS relationships.

Definitions

Information and communication technologies (ICT) are the hardware, software, network, and communication technologies that are combined and used to enable organizations to communicate, share or integrate data and transactions, and coordinate activities (Spanos et al. 2002). One example is the computer technology, telecommunication networks, software, and data standards used to enable EDI communication between organizations. Another example is the computer, telecommunication, software, and technical standards infrastructure that make up the Internet. For the purposes of this review, ICTs are defined as the interdependent sets of technologies that together provide the infrastructure that enable IOS operation. Within the perspective of recent history, ICTs are continuously changing and being improved upon (Grover & Goslar 1993), and becoming less expensive (Hitt 1999).

Interorganizational systems have been defined as the systems linking organizations in eMarkets and eHierachies (Malone et al. 1987), the ICT-based systems that "transcend" legal enterprise boundaries (Kumar & van Dissel 1996), or as the systems that facilitate the sharing of data with partners in order to increase business opportunities (Konsynski & McFarlan 1990). Within the context of this paper, an IOS is defined as the ICT-based systems that extend beyond an organization's legal boundaries and link otherwise independent organizations together to enable inter-firm relationships.

Inter-firm relationships are considered to be goal-oriented associations between otherwise independent organizations (Gulati 1998). Because they are outside the governance of a single firm's hierarchy structure, these relationships are characterized by higher degrees of trust and the mutual sharing of risks and returns in comparison to relationships that stay within the confines of a single firm (Das & Teng 2002a; Gulati 1995). A popular example in the IOS literature is the inter-firm relationship between independent travel agents and brokers who use the SABRE reservations system, and American Airlines, which owns SABRE. Another example is the inter-firm relationship between Ford Motors and its automotive suppliers who are involved in joint product design (Braunstein 1999).

The benefits of IOS use often increase as more partners become involved. Economic benefits typically increase as the fixed cost of IOS infrastructure is spread among more organizations. Economies of scale and scope are possible as more partners become involved. "Network effects" is the name given to the situation where the benefits to an existing body of participants increase as more actors become involved (Brickley et al. 2000). Network effects characterize many types of IOSs, such as in the example of the SABRE reservations system in the travel industry. As more and more airlines and travel agents become involved in SABRE, the benefits to existing partners increases through greater opportunities to buy or sell products to a greater market and share industry information among interested partners (Christiaanse & Venkatraman 2002).

IOS Classification Structures

Prior research in classifying IOS relationships focused on how lower ICT costs and increasing network effects would provide the economic motivation to move an organization's processes outside the firm's hierarchy and into a market structure. An early paper that had a great deal of influence on early IOS literature was written by Malone, Yates, and Benjamin in 1987. This article reflected a strong economic-based rationale based on transaction costs. The logic was that ICT-enabled participation in eMarkets would lower transaction costs and firms would thus be motivated to move from hierarchies to markets (Malone et al. 1987). This intuitive view was quite popular, forming the theoretical basis for several articles from the same general period (e.g. Benjamin et al. 1990; Konsynski 1993). The results of applying transaction-cost economics (TCE) in the IOS environment were not always consistent, however. For example, while Malone et al. (1987) predicted that organizational processes would move to eMarkets, others suggested firms might become more tightly interconnected (Clemons & Row 1992), while still others suggested changes in levels of vertical or horizontal integration (Gurbaxani & Whang 1991).

What also happened was that organizations evolved into hybrid or 'mixed-mode' forms where the inter-firm relationships took on varying degrees of both hierarchy and market characteristics (Holland & Lockett 1997). In other words, the IOS relationship could predominantly resemble a hierarchy, such as that found in a buyer-supplier relationship (Wilson & Vlosky 1998); a market (Benaroch & Kauffman 2000); or a clear mix of both (Chatfield & Bjorn-Andersen 1997). Mixed-mode forms, while certainly not ruled out in the transaction-based approach, were nevertheless not as neatly explainable as were eHeirarchies and eMarkets.

Recent work in examining IOS structures and management challenges focused on the types of relationships between firms engaged in an IOS. Theoretical perspectives in this research have included socio-political (Duncan & Kaufman 1996; Kumar & van Dissel 1996), competitive strategy (Kumar & Crook 1999), and resource dependency (Kumar & van Dissel 1996). While these typologies are useful, from a theoretical perspective they tend to fall short on two accounts. First, they often illustrate one type of inter-firm relationship dimension and relate it to a specific ICT set (Wang 2000). However, ICTs are associated with, but not definitive of, the IOS relationship, and as such may be limiting to future research. The second issue is that, with notable exceptions (e.g., Kumar & van Dissel 1996), the typologies are based more on empirical generalizations than on theory (e.g., Choudhury 1997). Distinct IOS types are shown to exist, but why or how the different types are related is not fully explained, affecting the ability of managers or researchers to understand IOS types in greater detail.

Kumar and van Dissel (1996) arguably have one of the most advanced typologies; however, it possibly loses some of the theoretical power it should rightly have since it is partially grounded in types of technology. These authors base their analysis on Thompson's concept of resource dependency (Thompson 1967), which proposes a hierarchical structure of dependencies. Another, more informative, view on resource dependency is provided by Pfeffer and Salancik (1978). This perspective suggests that dependencies are actually multi-dimensional: relationships can have multiple embedded relationship dependencies at once. The multi-dimensional perspective draws support from previous examples in the TCE-based literature that characterizes the IOS relationship as multi-dimensional ('mixed mode'). Based on the Pfeffer and Salancik version of resource dependency, understanding inter-firm relationships is regarded as understanding multi-dimensional inter-firm dependencies.

Pfeffer and Salancik draw on the industrial organization and sociology literatures in their development of resource dependency, a social control theory describing the external relationships between social actors. Resource dependency is considered an organizational dynamics theory that assumes organizations are influenced by the social, political, and task environment surrounding them. Organizations are further assumed to consider institutional survival as a fundamental motivation for action (Pfeffer & Salancik 1978). According to this line of reasoning, organizations respond most readily to the demands of outside organizations that control critical resources. Such resources can be tangible or intangible, and could include capital resources (land, labor, or capital), information, leadership, guidance, or institutional legitimacy (Oliver 1991). The concepts of interconnectedness and co-dependency are developed to illustrate how interorganizational relationships become mutually dependent. Pfeffer and Salancik (1978) show how relationships can simultaneously vary in their levels of both interconnectedness and co-dependency, creating multi-dimensional as opposed to hierarchical relationships.

Interconnectedness is defined as the pattern of relationships (linkages or connections) among organizations, specifically whether they involve an embedded sequential process (eg. an 'assembly line' process such as a workflow system

(Basu and Kumar 2002)) versus no embedded process (e.g. a 'bulletin board'-style information portal (Duncan and Kaufman 1996)). The pattern of Interconnectedness influences management challenges and relationship risk because the presence of a sequential process adds inherent stability and certainty to organizational processes through the coordinating properties of the process (Pfeffer & Salancik 1978, p. 69). For example, Basu and Kumar (2002) describe interorganizational workflow systems (eg. supply-chain management systems) as having characteristics of predictability and repeatability when the workflow is sequential because the roles and relationships of individual firms are transparent to each other - each knows what to do and what is expected, based on their position in the process. As the workflow becomes less sequential (e.g. parallel paths, pooled inputs or multiple outputs), the more important (i.e. intensive) workflow management becomes.

Co-dependency is defined as the nature of the relationships between organizations, particularly whether or not they are reciprocal (involving feedback) or uni-directional (little or no feedback, e.g., 'downstream' organizations do not communicate with 'upstream' firms). The nature of the co-dependency creates its own challenges and risks because reciprocal relationships introduce higher levels of direct and indirect dependencies that require additional stabilization efforts (Pfeffer & Salancik 1978). The higher the degree of co-dependency, the more uncertain and unstable the environment. Subsequent organizational behavior authors support the notion that degrees of co-dependency, whether or not a reciprocal relationship exists, are related to specific management challenges and risks (Das & Teng 2000, 2002b).

The key differentiating factor between interconnectedness and co-dependency is that the former relates to relationship structure (configuration of links) while the latter relates to relationship content (whether the link is bi- or unidirectional). The less linear and sequential the links, the less predictable and repeatable the process structure and the more management attention is required. Likewise, the greater the density of bi-directional links, the greater the opportunity for interaction with large numbers of partners, and the greater the need for management attention to address it.

We can now use interconnectedness and co-dependency as the two focal dimensions in constructing an analysis framework of four different IOS relationships: modular sequential (MS), modular pooled (MP), reciprocal sequential (RS), and reciprocal pooled (RP) - (see Figure 1). By combining co-dependency and interconnectedness, we are left with four inter-related types that are thought to differ in terms level of management intensity required to manage them.

IOS Typology

Modular-sequential IOS relationships are those that are interconnected in a uni-directional pattern and that involve a low degree of reciprocal relationships. Tasks and roles tend to be well defined and there is little or no need for a two-way data/information flow or feedback from others in the system. Most examples from the IOS literature involve inter-firm relationships that have a multi-step

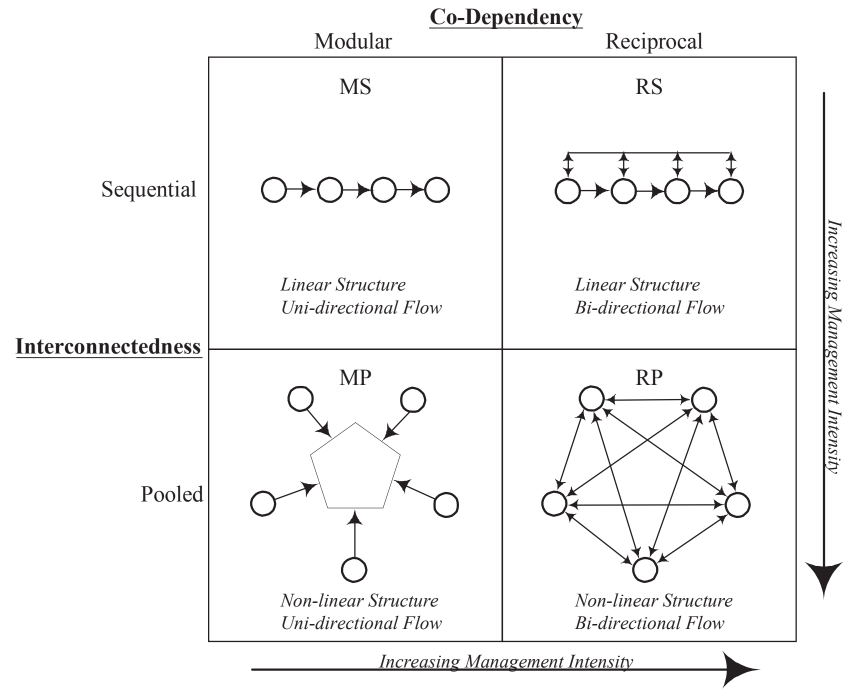

Figure 1. Interconnectedness and Co-Dependency Relationships in IOS

business process embedded within the group. One example is the integrated business process created to facilitate multi-party customer billing (Au & Kauffman 2001). In this example, three partners - banks, bill consolidators, and billers - pass information in a sequential process using an IOS. This type of relationship involves a low degree of reciprocity; once data are exchanged from one partner to the next in the process, there is no need, beyond confirmation of receipt of data, for an originator to have contact with anyone other than its direct exchange partner. However, the relationship is also linearly interconnected; the sequential nature of the embedded process means that each partner must properly contribute or all will suffer, but an embedded process provides a degree of implicit coordination and predictability. This structure is similar to the sequential interdependency relationship reported in Kumar and van Dissel (1996).

Modular-pooled IOS relationships involve partners that are loosely connected, and are not involved in a multi-step sequential process. An example is the relationship between larger retail buyers and suppliers, such as WalMart, and their network of suppliers (Wilson & Vlosky 1998). WalMart maintains a large number of direct, one-to-one relationships with its suppliers, which combined provide WalMart with the resources necessary to operate a substantial retail operation. No common process directly unites or coordinates the suppliers, but they have no reciprocal contact with each other either. This structure is similar to the pooled interdependency type in Kumar and van Dissel (1996).

Reciprocal-sequential IOS relationships involve partners who are linearly interconnected through an embedded process, and are highly co-dependent on each other's contributions to the relationship. The reciprocity is essential because the actions of any of the partners impact all the others despite the sequential nature of the process that the system supports. An example would be a joint-design IOS, such as those found in the automotive industry (Braunstein 1999). Ford Motors operates an IOS in the development of new automobile lines where parts suppliers are able to create and submit electronic designs as a part of the overall sequential engineering process. If changes are required after submission, for example if the designer of the suspension requires changes to the design of the fenders after the fender design has been submitted, the fender designer is alerted and changes are made. Each partner is able to directly impact the work of every other partner during the process, yet they are also part of the coordination process involved in automobile manufacturing.

The last type, reciprocal-pooled, are IOS relationships where partners are not linearly interconnected but are highly co-dependent. In this instance all system members can impact and are impacted by all other members. An example of this type of IOS relationship would be shared document management or Knowledge Management Systems (KMS). Majchrzak, Rice, Malhotra, King, and Ba (2000) report on the use of a shared document management system (in addition to other embedded systems) as a part of the IOS enabling a joint design process for a new rocket engine. In a shared KMS, partners do not have the coordinating benefits of an embedded process, yet are highly co-dependent on each other to provide useful documents for shared use.

We suggested earlier that understanding the management challenges and risks inherent in an IOS relationship is dependent on the type of IOS relationship concerned. The relevant literature will be reviewed and discriminated in the next section, based on the previous framework, and the management challenges and associated risks examined. We expect to see that there are similarities across the horizontal and vertical 'slices' of the typology (relationship differences based on degrees of interconnectedness and co-dependency), as well as an increasing number of challenges as we move from the MS type, through the RS and MP types, and finally to the RP type.

Methodology

Due to the nature of this research, typology development of IOS use in business settings, a literature review methodology was chosen for three reasons. First, the study of interorganizational systems has been a topic of interest in the MIS field for several decades, creating a rich body of prior work to draw from. Second, a successful strategy for typology development involves retrospective analysis of past work in order to search for latent recurring patterns in the data, matching purpose with method (Das and Teng, 2002a). Third, prior MIS research in developing research models and frameworks has successfully used the literature review method to contribute to the field (e.g. DeLone and McLean 2003). The availability of rich data, the match of purpose to method, and the past success of others using the same method influenced our choice of research technique.

The literature review was conducted between December 2002 and March 2003. A research assistant, who received specific training regarding this particular topic prior to the search effort, was hired to perform the search process. We followed the literature review and search method advocated by Webster and Watson (2002), augmented by Salipante, Notz and Bigelow (1982), which describes a multi-stage iterative process designed to provide maximum coverage of a topic for the purposes of a narrative literature review. A matrix approach (Webster and Watson, 2002) was used to organize and structure the analysis. In the first stage, we searched electronic databases (ABI-Inform, Google) with the following keywords: "interorganizational systems", "EDI", "electronic markets", "electronic hierarchies", "electronic collaboration", "hybrid organizations", and "virtual organizations". The results from these searches were individually examined and included in the review set if they satisfied three inclusion criteria: publication in a peer-reviewed journal (Gallupe and Tan, 1999); discussion of risks, management challenges, or relationships; and the acknowledged existence of an ICT-enabled collaborative environment. The search was intentionally cross-disciplinary, as it was expected prior to the search that relevant research articles fitting the inclusion criteria would be found in many research streams.

Within the set of articles from step one, each paper's citations were then examined for additional relevant articles that may have been missed in the initial search. The citation list of each article discovered in this step was successively examined until saturation was reached (no new articles were being located). As a final step, particularly influential articles, indicated by those research papers that tended to be cited much more heavily than others, were referenced in an online citation index (Web of Science, http://isi4.isiknowledge.com/portal.cgi/wos). Any new articles identified in this step had their citations checked for relevant articles that had not been previously identified.

Each paper was categorized into one of the four IOS typologies. The articles were divided between the two authors for individual coding, and each article was classified based on whether or not an embedded directional process was present ('degree of interconnectedness') and whether or not reciprocal relationships were present between partners (degree of 'co-dependency'). Coding reliability was established by each author re-coding a 15 percent sample of the other's classification. Inter-rater reliability was calculated to be 81 percent. Multiple entries for a single paper were created when the article clearly described more than one type of IOS. The management challenges, risks, and important relationship characteristics were also recorded. After this step was complete, the authors identified distinct themes in the challenges and risks within each typology.

	<1980	1980-84	1985-89	1990-94	1995-99	2000-03	Total	%
MIS Quarterly	0	0	1	3	8	5	17	14.9%
Journal of Management Information Systems	0	0	0	2	5	5	12	10.5%
Information Systems Research	0	0	0	0	5	3	8	7.0%
Information & Management	0	0	1	2	3	1	7	6.1%
Decision Support Systems	0	0	0	2	2	1	5	4.4%
Decision Sciences	0	0	0	0	4	0	4	3.5%
Communications of the ACM	0	0	0	0	2	1	3	2.6%
Journal of Business Logistics	0	0	1	1	1	0	3	2.6%
Organization Science	0	0	0	0	1	2	3	2.6%
Journal of Systems Management	0	0	0	1	2	0	3	2.6%
Sloan Management Review	0	0	1	0	2	0	3	2.6%
European Journal of Information Systems	0	0	0	0	2	0	2	1.8%
IEEE Transactions on Production Engineering	0	0	0	0	1	1	2	1.8%
Intl. J. of Physical Distribution & Logistics Mgmt.	0	0	0	0	1	1	2	1.8%
Industrial Management and Data Systems	0	0	0	0	1	1	2	1.8%
International Resources Management Journal	0	0	0	0	1	1	2	1.8%
Journal of Operations Management	0	0	0	0	0	2	2	1.8%
Journal of Strategic Information Systems	0	0	0	0	1	1	2	1.8%
Transportation Journal	0	0	0	0	1	1	2	1.8%
Other	2	1	1	4	16	6	30	26.3%
Total	2	1	5	15	59	32	114	
%	**1.8%**	**0.9%**	**4.4%**	**13.2%**	**51.8%**	**28.1%**		**100.0%**

Table 1. Distribution of Article Source and Year (114 articles)

Reported Management Challenges			**Distribution**			
Rank		**Freq.**	**MS**	**RS**	**MP**	**RP**
1	Power & benefit differences	33	3	7	18	5
2	User adoption	20		2	11	7
3	Process Coordination	17		12	1	4
4	Network effects	12		2	6	4
5	Change management	12		2	8	2
6	Risk	8		3	4	1
7	Cost/value	7		1	1	5
8	Interdependencies	6	3	1		2
9	Heterogeneous stakeholders	5			2	3
10	Trust	5		2		3
11	Managing mutual knowledge	4		2		2
12	Privacy	3			1	2
13	Fit	2				2
14	Standards	2			1	1
15	Growth	1			1	
16	Learning	1				1
17	Resource ownership	1				1
18	Design	1				1
19	Technology	1				1
	Total	141	6	34	54	47
	Number of Unique Challenges		2	10	11	18
	Number of Articles		6	38	38	28
	Unique Challenges / Article		33.3%	26.3%	28.9%	64.3%

Table 2. Distribution of Management Challenges by IOS Type

Results

Literature Review

The literature search process resulted in the identification of 147 articles that met the initial requirements for quality, discussion of the interorganizational relationship, and the presence of an ICT-enabled collaborative environment. Of these 147 articles, 33 were discarded because they either did not provide sufficient data indicating the IOS type (14); the results were not specific to a particular IOS type (8); or the article did not sufficiently specify what the IOS was being used for or what the management challenges were (5). In addition, upon closer inspection six articles were found to be outside the IOS domain (outsourcing or single-organization context). In total, 114 research articles were analyzed. Table 1 displays article source distributed across the sampling timeframe (1976 to 2003). Table 2 shows the distribution of articles and reported management challenges across the different IOS types. The complete results from the review methodology are available in Appendix A.

The articles under review show wide diversity in age, source, technologies used, and industries. This result is consistent with several assumptions of the review, that IOS use is neither confined to certain industries or technologies, nor is the research grounded in only one discipline or at one period of time. The articles span a period from 1976 (Quinn 1976) to 2003 (Teo et al. 2003), and are found in the MIS (e.g., Benasou 1997), Marketing (e.g., Vijayasarathy & Tyler 1997), Organizational Behavior (e.g., Holland & Lockett 1997), and Operations Management (e.g., Wang & Seidmann 1995) literatures. Several different technologies are used, such as EDI (e.g., Iacovou et al. 1995), Internet (e.g., Chircu & Kauffman 2000), or third party proprietary systems (e.g., Vijayasarathy & Tyler 1997). Multiple industries are represented as well, such as manufacturing (e.g., Braunstein 1999), retail (e.g., Vijayasarathy & Tyler 1997), service (e.g., Duncan & Kaufman 1996), and travel (e.g., Chatfield & Bjorn-Andersen 1997).

As Table 1 shows, over half the articles originated in mainstream MIS journals, with a third of them (32.4%) coming from what are commonly considered as the top three journals in the discipline (MIS Quarterly, Information Systems Research, and Journal of Management Information Systems). These results support our intention of sourcing high-quality research. The remaining articles come from a variety of additional sources, primarily from engineering and operations management disciplines. While the distribution of articles was spread over the period from pre-1980 (n=2) to 2003, the overwhelming majority of articles have been published in the past decade (1990-2003, n=106). While we can not say for sure, it is our expectation that this result reflects the increased focus on interorganizational relationships subsequent to the introduction and adoption of Internet technologies in organizations in the 1990s.

In regard to the distribution of management challenges reported in the articles under review, we found a total of 6 articles describing MS-type relationships, 38 articles describing RS-type relationships, 38 articles describing MP-type

Inter-connectedness	Co-Dependency: Modular	Co-Dependency: Reciprocal
Sequential	**MS** Au & Kauffman, 2001 Basu & Kumar, 2002 Benasou, 1997 Chatfield & Bjorn-Andersen, 1997 Chwelos et al., 2001 Kumar & van Dissel, 1996	**RS** Alt et al., 2000 Benjamin & Wigand, 1995 Braunstein, 1999 Clemons & Kleindorfer, 1992 Dutta & Kendall, 2002 Forster & Regan, 2001 Hart & Saunders, 1998 Hoogeweegen et al., 1999 Kumar & van Dissel, 1996 Lau & Lee, 2000 Majchrzak et al., 2000 Malhotra et al., 2001 Maltz & Srivastava, 1997 McLaren, 2002 Mukhopadhyay et al., 1995 Raghunathan & Yeh, 2001 Raghunathan, 1999 Riggins & Rhee, 1998 Rockart & Short, 1989 Scott, 2000 Shah et al., 2002 Song & Nagi, 1997 Tiwana & Ramesh, 2001 Walton & Miller, 1995 Williams, 1994
Pooled	**MP** Bakos, 1991 Barua & Lee, 1997 Benaroch & Kauffman, 2000 Chatfield & Bjorn-Andersen, 1997 Chatfield & Yetton, 2000 Chen & Sheldon, 1997 Chircu & Kauffman, 2000 Chircu et al., 2001 Chismar & Meier, 1992 Choudhury et al., 1998 Choudhury et al., 1998 Christiaanse & Venkatraman, 2002 Cox & Ghoneim, 1998 Damsgaard & Lyytinen, 2001 Duliba et al., 2001 Duncan & Kaufman, 1996 El Sawy et al., 1999 Emmelhainz, 1988 Farrell & Song, 1988 Fredriksson & Vilgon, 1996 Golden & Powell, 1999 Hansen and Hill, 1989 Iacovou et al., 1995 Jelassi & Figon, 1994 Jimenez-Martinez & Polo-Redondo, 1998 Jones & Beatty, 2001 Jun et al., 2000 Kumar & Crook, 1999 Kumar & van Dissel, 1996 Lang & Zhao, 2000 Lee, 1998 Lee, et al., 1999 Neo, 1994 Nidumolu, 1995 Premkumar & Ramamurthy, 1995 Riggins & Mukhopadhyay, 1994 Rode, 1993 Rosenthal et al., 1993 Segev et al., 1997 Strader & Shaw, 1997 Suomi, 1988 Suomi, 1994 Teo et al., 1997 Teo et al., 2003 Venkatraman & Henderson, 1998 Vijayasarathy & Tyler, 1997 Vlosky et al., 1994 Wang & Seidmann, 1995 Wilson & Vlosky, 1998	**RP** Arunachalam, 1997 Bakos & Nault, 1997 Bellamy & Taylor, 1996 Bensaou & Venkatraman, 1996 Bergeron & Raymond, 1997 Chen & Williams, 1998 Ching et al., 1996 Cramton, 2001 Damsgaard & Lyytinen, 1998 Gupta, 1995 Harold, 1997 Hauenstein & Grupe, 1994 Hendon et al., 1998 Karahannas & Jones, 1999 Kumar and Crook, 1996 Kumar et al., 1998 Majchrzak et al., 2000 McFarlan, 1982 Monge et al., 1998 Murphy & Daley, 1999 Payton & Ginzberg, 2001 Payton, 2000 Premkumar & Ramamurthy, 1995 Premkumar et al., 1994 Quinn, 1976 Rule & Keown, 1998 Sarkar et al., 1996 Schermerhorm Jr., 1977 Stock et al., 2000 Sutter, 2000 Suzuki & Williams, 1998 Truman, 2000 Turoff et al., 1993 Zeffane, 1994

Figure 2. Literature Review Results Segmented By IOS Type.

relationships, and 28 articles describing RP-type relationships (Table 2). When the reported challenges were compared for similarities it was determined that there were 2 unique management challenges being reported for the MS IOS type, 10 unique management challenges for the RS-type IOS, 11 unique management challenges for the MP-type IOS, and 18 unique management challenges for the RP-type IOS. After correcting for differences in number of articles per type , we calculated management challenge indexes for each IOS type, which were 0.33(MS), 0.26 (RS), 0.29(MP), and 0.64(RP). We interpret these values to indicate that the number of management challenges vary according to the type of IOS relationship, where the modular-sequential type, reciprocal-sequential and modular-pooled types are approximately equal (range from 0.26 to 0.33), while the RP type is associated with well over twice the number of challenges.

As expected, the authors found multiple examples for each IOS type. Figure 2 illustrates the distribution of the research articles by IOS type. The dominant management themes, by IOS type, are shown in Figure 3.

Co-Dependency

Inter-connectedness	Modular	Reciprocal
Sequential	• Power and Benefit Differences • Interdependencies	• Power and Benefit Differences • Interdependencies • User Adoption • Process Coordination • Network Effects • Change Management • Risk • Managing Mutual Knowledge • Cost/Value • Trust
Pooled	• Power and Benefit Differences • Multiple heterogeneous stakeholders • User Adoption • Process Coordination • Network Effects • Change Management • Risk • Privacy • Cost/Value • Standards • Growth	• Power and Benefit Differences • Multiple heterogeneous stakeholders • User Adoption • Process Coordination • Network Effects • Change Management • Risk • Privacy • Cost/Value • Standards • Learning • Resource Ownership • Design • Technology

Figure 3. IOS Management Issues Segmented By IOS Type

IOS Typology

Figure three illustrates the four IOS types as four quadrants in an XY framework: the reciprocal-sequential in quadrant 1, modular-sequential in quadrant 2, modular-pooled in quadrant 3, and reciprocal-pooled in quadrant 4. Certain characteristics are common across several types, such as a need for trust between partners. This is not surprising given the importance of trust to relationships overall (Ford 2003). Figure 3 also shows that the characteristic management challenges are not evenly distributed throughout the typology. Patterns appear that are associated with horizontal and vertical 'slices'. Each type 'inherits' characteristics from each dimension in the typology, creating characteristic 'management signatures' definitive of that IOS type. Separating the IOS management literature along two dimensions suggested by resource dependency theory has provided a typology of IOS relationships that tend to converge and that exhibit unique management challenge signatures. These results strongly support the original premise that the different IOS relationships are not created equal and are related in such a way that management challenges increase in patterns that are consistent with expectations.

Discussion

In this article we have suggested that IOS relationships are differentiated by the nature and degree of the resource dependencies embedded within interorganizational connections. This premise was supported by the literature review results. The number of unique management challenges associated with participating in an IOS-enabled relationship with other firms increases as the type of IOS changes. We would have preferred to see a greater discrepancy between the modular-sequential type and the reciprocal-sequential and modular-pooled types, as our initial expectations led us to believe. However, we do note that we recorded only two unique challenges associated managing the MS type (as reported in only six articles), while we noted 10 and 11 issues associated with the RS and MP types (as reported in 34 and 54 articles, respectively). We suspect that had there been more articles detailing the MS type of IOS we would not have seen many more challenges being reported in the additional reports and the expected differentiation between these types would have emerged. Of course, we have no way of empirically substantiating this claim with our dataset. This issue is further addressed in the limitations section.

In the following section we will use the results of the literature review to illustrate why co-dependence and interconnectedness differentiate IOS relationships into the four types demonstrated above, and how these differences are associated with variations in the number and type of management challenges. The fundamental nature of these relationships will then be captured in a series of propositions that encapsulate the embedded resource dependency theory of IOS management. This theory will then be applied to two outstanding questions in the IOS literature: whether technology-specific IOS research represents a conceptually distinct field of study, and why e-Hierarchies and e-Markets might emerge as they do.

IOS Typology and Embedded Resource Dependencies

Interconnectedness in the IOS context, whether sequential or pooled, essentially represents the presence or absence of a multi-stage directional process embedded within an interorganizational relationship. As an embedded sequential process (i.e. workflow) becomes less linear and more parallel or multi-pathed, the environment becomes more uncertain and unstable (Pfeffer & Salancik 1978). Accordingly, relationship management risks and challenges increase (e.g. Chen and Sheldon 1997).

Co-dependencies, either modular or reciprocal, vary by the degree to which partners have two-way (reciprocal) contact with each other. Greater degrees of mutual dependence (co-dependence) increase the requirement to take other participants into account when making individual decisions (Pfeffer & Salancik 1978). As a result, management effort increases. In the case of IOS relationships, increasing co-dependencies lead to an increased importance in managing issues of information exchange and mutual knowledge (e.g. Cramton 2001; Majchrzak et al. 2000; Tiwana and Ramesh 2001). As the degree of co-dependence increases, IOS relationship management concerns increase more than technology issues because of an increased need to consider partners when making individual decisions with potentially boundary-spanning impact.

Differentiating IOS relationships according to the type and degree of embedded resource dependencies leads to the development of four theoretically distinct, and empirically supported, types. These four types are predictably interrelated. The underlying theory for a resource dependency based perspective of IOS management is outlined in the following section.

Managing IOS Relationships

The resource dependency based premise holds that differences in co-dependency and interconnectedness lead to IOS types that correspond with predictable increases in specific types of management risks and challenges. Co-dependency and interconnectedness affect the IOS relationship in fundamentally different ways, such that certain IOS types are inherently more management intensive than others.

In terms of co-dependencies, as the ratio of the number of bi-directional links to total links ('density': Burt 1992) increases, co-dependencies increase as well. The presence of multiple reciprocal connections creates a 'web' that escalates in density as the number of bi-directional connections increase. The more dense the web, the greater the need for coordinating and control mechanisms and the greater the management difficulties (Pfeffer & Salancik 1978; Weick 1976).

For example, researchers have shown that firms must increasingly address difficulties in coordinating the timeliness and recency of information when partners can access or modify each other's work, such as in newspaper and magazine publishing (Tiwana and Ramesh 2001), or in a manufacturing supply chain (Lau and Lee 2000). Firms must also manage collaboration between all members they have contact with in terms of understanding and meeting potentially conflicting expectations (Scott 2000). Finally, change management and technology standards play larger roles as the number of simultaneously-linked IOS partners increases (Forster and Regan 2001; Braunstein 1999). Stated in propositional terms:

> ***Proposition 1:*** *As the density of bi-directional electronic links between IOS participants increases, the greater the management intensity associated with the IOS.*

In terms of interconnectedness, as larger and more multi-pathed processes become embedded in an interorganizational relationship, the structure of IOS interconnectedness becomes less sequential. This structural change increases system uncertainty and instability as IOS participants progressively lose the coordinating and controlling characteristics of a linear sequential process (the linearity decreases).

For example, while firms involved in interorganizational systems involving sequential workflows may be concerned with issues such as avoiding the excessively influencing power of dominant IOS partners somewhere in the process (Basu and Kumar 2002; Au and Kauffman 2001), they are rarely concerned with issues such as privacy (Monge et al. 1998), change management (Rode 1993; Segev et al. 1997), dealing with heterogeneous stakeholders (Duncan and Kaufman 1996), or network effects (Chircu and Kauffman 2000; Zeffane 1994). Stated in propositional terms:

> ***Proposition 2:*** *As the linearity of electronic connections between IOS participants decreases, the greater the management intensity associated with the IOS.*

Taken together, differences in the levels of interconnectedness and co-dependency define four distinct IOS types that differ in their degree of dependencies. The extent of the management challenges for each of these four types differs accordingly, such that:

> ***Proposition 3:*** *Levels of management intensity vary according to the dependency relationships involved, such that, relatively speaking, Reciprocal-Pooled are the most management intense, Modular-Pooled and Reciprocal-Sequential moderately management intense, and Modular-Sequential the least management intense.*

Propositions one to three illustrate specifically how and why management challenges and operational risks increase as IOS partners become less linear and more bi-directional. However, difference in interconnections and co-dependencies between firms in an IOS affect more than just management considerations. As mentioned earlier, at the very heart of these systems lie the information and communication technologies that enable these relationships to occur and become more prolific over time. By definition, each firm participating in an IOS must therefore use these technologies. The use of standard technologies, such as networking or Internet standards (e.g., Kayworth & Sambamurthy 2000; Gallaugher & Wang 2002), is not only a practical prerequisite for ICT-mediated communication among firms, but it is also influenced by the extent of adoption (Chau & Tam 1997). For example, the more firms in an IOS become directly entwined through co-dependency and interconnections, the greater the extent to which everyone must use the same technologies. The more everyone must use the same technologies, the more they are directly affected when the technologies change, evolve, or are substituted with others. In other words, as firms in an IOS relationship become more tightly coupled, the more embedded a specific technology likely becomes. Accordingly, the more embedded a technology becomes, the higher the number of independent firms that are simultaneously affected. Based on this line of reasoning, grounded in the argument that dependencies constrain actions (Pfeffer & Salancik 1978), our position is that tighter coupling leads to deeper embedding of the technologies and standards involved in enabling the IOS relationship, which increasingly limits the ability of the collective firms to adapt, change, or substitute IOS-enabling technologies.

Co-dependencies increase by the degree to which each partner is connected to all the other partners. This situation has a significant effect on the ability of the partner firms to change their ICT infrastructure independently of others in the same network. Recall that, as the level of co-dependency increases, individual firms become directly connected to more partners in the network (see Figure 1). Accordingly, the ease with which ICT changes can occur decreases, as the decision simultaneously affects a higher number of independent firms. It is the simultaneity that drives the effect; in the case of reciprocal co-dependency (Figure 1, right hand side), everyone must plan, synchronize, adopt, and deal with change in parallel, resulting in significant coordination costs (e.g. Braunstein 1999). Prior empirical support is also provided by researchers who have reported how managing initial technology adoption is a significant challenge to administering distributed distance education interorganizational systems where students, instructors, and administrators are all simultaneously interacting through the technology (Lang and Zhao 2000). Stated in propositional form:

> ***Proposition 4:*** *As the density of bi-directional electronic links between IOS participants increases, the ease with which IOS-enabling technology can be adopted or changed decreases.*

The manner in which an inter-firm relationship is structured also influences how easily technology and standards can change. The presence of a sequential process within the network of organizational connections represents a situation where, at best, a firm may only interact with two other partners, even though there may be many more firms involved in the IOS. While adoption or changes in IOS technology often involve all participants (Iacovou et al. 1996), strictly speaking it may only involve one firm and its direct partners. While this simplified example is rarely seen in practice, it does provide contrast for examples that are seen in practice. For example, the effort involved in changing and updating technology when firms are connected in a reciprocal-pooled IOS is mentioned in Majchrzak et al. (2000). In this case, all participants in a shared product development IOS were required to access and update information to enable the system to work as originally planned. Because of the interactive ('reciprocal') and pooled nature of the work (and the IOS), all organizations were required to adopt technology changes in synchronicity or risk not only being left out, but also denying others an opportunity to communicate with them. In this situation one firm's change management practices affects all partners. This effect is also evidenced in the attention given to being able to adopt new technology in synchronicity with all other partners in order to remain competitive in reservation system contexts (Cox and Ghoneim 1998; Fredriksson and Vilgon 1996). The type of interconnectedness between firms in an IOS affects the degree to which technology and standards can change:

> ***Proposition 5:*** *As the linearity of connections between IOS participants decreases, the ease with which IOS-enabling technology can be adopted or changed decreases.*

Taken together, the dual effects of co-dependency and interconnectedness on IOS participant firms influences the relative flexibility of each relationship type to adopt, change, or evolve the IOS-enabling technologies:

> ***Proposition 6:*** *The ease with which IOS-enabling technology can be adopted or changed among IOS participants varies according to the dependency relationships involved, such that, relatively speaking, Reciprocal-Pooled are the most resistant to change, Modular-Pooled and Reciprocal-Sequential moderately resistant to change, and Modular-Sequential the least resistant to change.*

Relative differences with respect to ease of adoption have a particularly interesting consequence. If differences exist then the implication is that, all else being equal, the diffusion of technology within IOSs should follow a reasonably predictable pattern:

> ***Corollary:*** *The diffusion of new IOS-enabling technologies and standards in IOS relationships is most likely to occur first with Modular-Sequential IOS relationships ('early adopters'), followed by Modular-Pooled and Reciprocal-Sequential IOS relationships ('middle adopters'), and last by Reciprocal-Pooled IOS relationships ('late adopters').*

The IOS embedded resource dependency propositions as stated above represents the findings in this paper. We can also apply the typology to provide a new perspective on two long-standing questions in IOS literature: whether technology-specific IOS research represents a conceptually distinct field of study; and why IOS relationships do not fully gravitate to eHierarchies or eMarkets.

Implications for Researchers

The IOS literature is deeply fragmented along technology lines. Distinct, technology-based literatures exist based on EDI (Benjamin et al. 1990; Iacovou et al. 1995; Massetti & Zmud 1996; Vlosky et al. 1994; Wang & Seidmann 1995), Internet (Chircu et al. 2001; Narayandas et al. 2002; Venkatraman 2000), and customer reservation systems (CRS) (Chircu et al. 2001; Chismar & Meier 1992; Christiaanse & Venkatraman 2002; Duliba et al. 2001), to name just a few. The casual reader would be justified in believing that these different areas of research are in fact largely distinct and do not share many similarities aside from the interorganizational relationship. As researchers, an important question is whether the distinctions are justified.

In some cases these lines of inquiry are justified in focusing on a particular technology, such as research in the transformation of organizational competencies and relationships as ICTs evolve (Christiaanse & Venkatraman 2002). In most cases, however, IOS research does not realize its full potential when these results are not placed in the broader nomological context whenever possible. This article demonstrates that IOS relationships need not be defined by the technology that enables the relationship, and that in fact the body of IOS literature is conceptually inter-related through fundamental relationship similarities. For example, EDI-based supply-chain research shares conceptual similarities to CRS research as well as with Internet-based business-to-business research through the intersection of similar resource dependency constraints. A multitude of opportunities exists to leverage the theory developed in this paper, and to apply the knowledge acquired in well-developed IOS research streams, such as EDI, in new and innovative places, such as Internet markets or auctions, that share dependency types. Embedded resource dependency theory suggests that technology-specific IOS research streams are not conceptually distinct fields of study.

A second and more persistent question in the IOS literature is whether IOS relationships represent eHierarchies (eH) and eMarkets (eM) (Benjamin et al. 1990; Holland & Lockett 1997; Konsynski 1993; Malone et al. 1987). Using the terminology developed in this paper, eH are typically defined as Modular-Pooled (MP) structures where a single dominant participant is the sole source of the majority of IOS resources. A common example is that of the American Hospital Supply Corporation's (AHS) single-source IOS (Main & Short 1989). eM are considered as MP structures where a single dominant participant pulls together resources from multiple sources and makes them available centrally to others. A popular example of this in the IOS literature is the SABRE CRS (Christiaanse & Venkatraman 2002). As eM and eH can be thought of as different configurations of the MP IOS typology the reasons for why different paths are taken could be examined from a technological, structural or institutional perspective. For example, it is possible that the technological capabilities available to those seeking to develop an IOS has impacted the choice of system. This implies a longitudinal study possibly using secondary data. As well, the structure of specific industries might lend itself more readily to certain types of systems. Finally, a different theoretical lens such as institutional theory (Scott 2001, DiMaggio & Powell, 1983) might provide considerable explanatory power in seeking to resolve this issue.

An IOS embedded resource dependency perspective suggests that there may be more hybrid or 'mixed mode' relationships than eHierarchies or eMarkets because there are certain types of interorganizational relationships that require different structural forms than purely eH or eM forms, such as when organizations collaborate under a common sequential process (Au & Kauffman 2001; Dutta & Kendall 2002). 'Mixed form' IOSs may originate when embedded dependency considerations outweigh the economic considerations that support the gravitation to either eHierarchies or eMarkets.

The debate whether eH and eM are distinct types introduces an interesting question for future research. While this paper explains how embedded relationships affect the IOS environment, it says little about how power differences between participants affect relationships. For example, within the context of MP relationship types, in some cases a central organization typically has a greater level of power within the larger IOS relationship to the detriment of non-central participants (Iacovou et al. 1995; Vlosky et al. 1994). However, it is not always the case that Modular-Pooled IOSs involve a central entity with higher power levels than other participants (Benaroch & Kauffman 2000; Duliba et al. 2001); or that power differences are considered harmful when they are present (Nidumolu 1995). It should be noted that we have not attempted to differentiate based on the strength of the relationships. This does not mean that strength, represented for example by duration or shared history of the relationships between firms, is not an important characteristics of IOS management, and indeed this dimension has the potential to offer significant insights into the typology proposed here, as well as in extending the propositions. These results suggest a fascinating array of potential questions related to power differences among IOS participants. For example, are power differences inherent in an IOS, or are interorganizational relationships that involve partners with resource and size differences simply more easily enabled by one IOS type over another (e.g., buyer-seller relationships and MP structures)? Further, are different IOS environments power-enhancing or power-neutral to varying degrees?

As the previous examples show, conflicting results are present when relationship dependencies are otherwise held constant, indicating that within each quadrant there exist potential moderators to the theory described in this paper. Additional factors such as resource ownership (Cash & Konsynski 1985; Lewis & Talalayevsky 2000), network effect benefits (Chircu et al. 2001), strength of relationship ties (Chen & Sheldon 1997; Granovetter 1973), or ownership of specific knowledge (Christiaanse & Venkatraman 2002) are all potentially valuable additions for a 'Z' dimension to the theoretical framework presented in this paper.

Limitations

We followed the methodology and analytical style for literature reviews advocated by Webster and Watson (2002) and Salipante et al. (1982). Adhering to these guidelines allowed us to build a structured, coherent review of the topic, leading to a review that offers both breadth and depth. While Webster and Watson (2002) do not specifically refer to rigour in their article it is certainly implicit in the degree of effort and detail that they advocate. They refer to "thoroughness" as a desirable characteristic for an ideal review. In our review we have attempted to meet the criteria of Webster and Watson's recommendations by thoroughly examining relevant prior literature in IS and related areas. This provides the foundation for the analytical and model building efforts which followed as well as the basis for recommending future research based on our findings. However, this methodology, no matter how scrupulously followed is not without limitations.

One potential shortcoming of our specific implementation of this method is the deductive style we adopted, first proposing a theoretical model, empirically validating it through the literature review, and then using it to develop our seven propositions. This method, however, is a relevant and accepted way to integrate and advance an area of research (e.g. Das and Teng 2002a). We were able to demonstrate the existence of four theoretically and conceptually distinct IOS typologies, which we feel are inclusive yet parsimonious. However, it is difficult under this method to establish that there are not more than four types. An inductive review process, following a grounded research method, for example, might discover a different typology structure. We recognize the shortcoming of the deductive method; we also recognize that future research may benefit from the approach adopted here.

A second limitation involves the small number of articles representing the modular-sequential IOS type in our dataset, which limits the efficacy of our management challenge index (unique challenges reported, corrected for unequal article counts). We found only two unique challenges associated with this type (power and value appropriation differences between partners and interdependency differences) while we found five times that number of unique challenges in what we believe to be the next most challenging IOS relationships, indicating that the types do vary as expected. However, after correcting for number of articles the difference between types disappears. This limits our interpretations of the data as we cannot say that the expected differences emerge after corrections have been made to put the results on equal footing across types. However, Table 2 does offer a stark qualitative contrast between types. There are clearly an increasing number of unique challenges per type as one moves from the left-most column to the right-most, consistent with our expectations.. Nevertheless, the results must be interpreted with the knowledge that differences between the types was not entirely established empirically, although we believe this was due to sample sizes versus actual similarities.

Conclusion

This paper started with the premise that interorganizational systems are not all created equal, but are all related in such a way that influences their manageability and conduciveness to change. This principle was theoretically established and empirically supported. The associations between IOS types and the management challenges that characterize them were represented as a series of propositions that together define the embedded resource dependency theory of IOS management. This theory was used to provide a new perspective on two enduring questions: whether technology-specific IOS research represents conceptually distinct fields of research, and why eHierarchies and eMarkets may not necessarily polarize as ICT costs fall. The quality of the theory can be at least partially judged by the extent to which these explanations were logically sufficient and satisfying. The discussion concluded with a number of potential moderators to the relationships described in the theory, such as differences in power and relationship strength between IOS participants. These moderators represent a wide variety of future research opportunities for continuing interorganizational system investigation.

Additional research is required. The IOS management literature is unevenly distributed among the various IOS types. As it stands now we know a great deal more about managing Modular-Pooled IOSs than we do about any other type. In addition, the research that is available in the other three quadrants is primarily descriptive. Given that the four quadrants are theoretically linked, there exist rich possibilities for future researchers to develop innovative propositions for exploring a lesser-researched quadrant based on the significant results in another. For example, in what ways, and to what degree, do inter-organizational processes impair change management? What are the tradeoffs between individual flexibility versus group stability for the firms involved in an IOS? How do these relationships change over time? Is there a progression where firms might tend to 'test the waters' by becoming involved in MP-type relationships, and then progress to other forms? Are the lessons learned in one type of relationship transferable in the next, and might this process provide insight into the way firms learn about and become proficient in leveraging technology-enabled relationships with other firms?

IOS management is not defined by the technology being used, but by the relationships embedded in the associations between partners. This does not mean that technology is unimportant. Understanding how resource ownership affects relationships is another under-researched area. Understanding how ownership of rapidly evolving resources manifests itself in a joint-use environment is understood even less.

ICTs are becoming less expensive, and new uses are continually being found. At the same time, the Internet boom has led to dramatic increases in North American and European telecommunications infrastructure. More pervasive and ubiquitous ICT use in interorganizational relationships seems a foregone conclusion. Larger questions regarding the future nature and boundaries of organizations and the effects of these changes on the people involved should again rise in importance as they did 20 years ago. For example, George Huber wrote an influential 1990 article about the effects of advanced technologies on the structure of organizations in the future. This question begs to be re-examined in light of the advances in ICT since then. For example, given the effects of IOS type on the ability of firms to change, does the possibility exist that membership in well-established, tightly connected interorganizational systems lead firms to become more alike over time as they increasingly adopt technology in parallel? Does membership in an IOS represent an 'Iron Cage' to firms, leading them to become more alike over time through some version of 'electronic isomorphism' (DiMaggio & Powell 1983)? What effect would this have on the inter-organizational landscape of the future? These issues represent an exciting new frontier in management study. In the true nature of scientific review, the seeds of our future questions could be wrapped in our past.

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References

Alt, R., Fleisch, E., and Osterle, H. "Electronic Commerce and Supply Chain Management AT ETA Fabriques D'Ebauches SA," *Journal of Electronic Commerce Research* (1:2), 2000, pp. 67-78.

Arunachalam, V. "Electronic Data Interchange: Issues in Adoption and Management," *Information Resources Management Journal* (10:2), 1997, pp. 22-31.

Au, Y.A., and Kauffman, R.J. "Should We Wait? Network Externalities, Compatibility, and Electronic Billing Option," *Journal of Management Information Systems* (18:2), 2001, pp. 47-63.

Bakos, J.Y. "A Strategic Analysis of Electronic Marketplaces," *MIS Quarterly*, 1991, pp. 295-310.

Bakos, J.Y., and Nault, B.R. "Ownership and Investment in Electronic Networks," *Information Systems Research* (8:4), 1997, pp. 321-341.

Barua, A., and Lee, B. "An Economic Analysis of the Introduction of an Electronic Data Interchange System," *ISR: A Journal of the Institute of Management Sciences* (8:4), 1997, pp. 398-422.

Basu, A., and Kumar, A. "Research Commentary: Workflow Management Issues in e-business," *Information Systems Research* (13:1), 2002, pp. 1-14.

Bellamy, C., and Taylor, J. "New Information and Communications Technologies and Institutional Change: The Case of the UK Criminal Justice System," *International Journal of Public Sector Management* (9:4), 1996, pp. 51-69.

Benaroch, M., and Kauffman, R.J. "Justifying Electronic Banking Network Expansion Using Real Options Analysis," *MIS Quarterly* (24:2), 2000, pp. 197-225.

Benasou, M. "Interorganizational Cooperations: The Role of Information Technology An Empirical Comparison of U.S. and Japanese Supplier Relations," *Information Systems Research* (8:2), 1997, pp. 107-124.

Bensaou, M., and Venkatraman, N. "Inter-organizational Relationships and Information Technology: A Conceptual Synthesis and a Research Framework," *European Journal of Information Systems* (5), 1996, pp. 84-91.

Benjamin, R., and Wigand, R. "Electronic Markets and Virtual Value Chains on the Information Superhighway," *Sloan Management Review*, 1995, pp. 62-72.

Benjamin, R.I., de Long, D.W., and Morton, M.S.S. "Electronic Data Interchange: How Much Competitive Advantage?," *Long Range Planning* (23:1), 1990, pp. 29-40.

Bergeron, F., and Raymond, L. "Managing EDI for Corporate Advantage: A Longitudinal Study," *Information & Management* (31:6), 1997, pp. 319-333.

Braunstein, J. "Ford Motor's software revolution," *Manufacturing Engineering* (123:5), 1999, pp. 64-69.

Brickley, J.A., Smith, C.W., and Zimmerman, J.L. *Managerial Economics and Organizational Architecture*, McGraw-Hill Irwin, New York, 2000.

Burt, R.S. *Structural Holes: The Social Structure of Competition* Harvard University Press, Cambridge. 1992

Cash, J.I.J., and Konsynski, B.R. "IS Redraws Competitive Boundaries," *Harvard Business Review* (63:2), 1985, pp. 134-142.

Chatfield, A.T., and Bjorn-Andersen, N. "The Impact of IOS-Enabled Business Process Change on Business Outcomes: Transformation of the Value Chain of Japan Airlines," *Journal of Management Information Systems* (14:1), 1997, pp. 13-40.

Chatfield, A.T., and Yetton, P. "Strategic Payoff from EDI as a Function of EDI Embeddedness," *Journal of Management Information Systems* (16:4), 2000, pp. 195-224.

Chau, P.Y.K., and Tam, K.Y. "Factors Affecting the Adoption of Open Systems: An Exploratory Study," *MIS Quarterly* (21:1), 1997, pp. 1-24.

Chen, H.-M., and Sheldon, P.J. "Destination Information Systems: Design Issues and Directions," *Journal of Management Information Systems* (14:2), 1997, pp. 151-176.

Chen, J.-C., and Williams, B.C. "The Impact of Electronic Data Interchange (EDI) on SMEs: Summary of Eight British Case Studies," *Journal of Small Business Management*, 1998, pp. 68-72.

Ching, C., Holsapple, C.W., and Whinston, A.B. "Toward IT Support for Coordination in Network Organizations," *Information & Management* (30), 1996, pp. 179-199.

Chircu, A.M., and Kauffman, R.J. "Limits to Value in Electronic Commerce-Related IT Investments," *Journal of Management Information Systems* (17:2), 2000, pp. 59-80.

Chircu, A.M., Kauffman, R.J., and Keskey, D. "Maximizing the Value of Internet-based Corporate Travel Reservation Systems," *Communications of the ACM* (44:11), 2001, pp. 57-63.

Chismar, W.G., and Meier, J. "A Model of Competing Interorganizational Systems and its Application to Airline Reservation Systems," *Decision Support Systems* (8:5), 1992, pp. 447-458.

Choudhury, V. "Strategic Choices in the Development of Interorganizational Information Systems," *Information Systems Research* (8:1), 1997, pp. 1-24.

Choudhury, V., Hartzel, K.S., and Konsynski, B.R. "Uses and Consequences of Electronic Markets: An Empirical Investigation in the Aircraft Parts Industry," *MIS Quarterly*), 1998, pp. 471-507.

Christiaanse, E., and Venkatraman, N. "Beyond SABRE: An Empirical Test of Expertise Exploitation in Electronic Channels," *MIS Quarterly* (26:1), 2002, pp. 15-38.

Chwelos, P., Benbasat, I., and Dexter, A.S. "Research Report: Empirical

Test of an EDI Adoption Model," *Information Systems Research* (12:3), 2001, pp. 304-321.

Clemons, E.K., and Kleindorfer, P.R. "An Economic Analysis of Interorganizational Information Technology," *Decision Support Systems* (8:5), 1992, pp. 431-447.

Clemons, E.K., and Row, M.C. "Information Technology and Industrial Cooperation: The Changing Economics of Coordination and Ownership," *Journal of Management Information Systems* (9:2), 1992, pp. 9-30.

Cohen, W.M., and Levinthal, D.A. "Innovation and Learning: The Two Faces of R&D," *The Economic Journal* (99:397), September 1989, pp. 569-597.

Cox, B., and Ghoneim, S. "Strategic Use of EDI in the Public Sector: the HMSO Case Study," *Journal of Strategic Information Systems* (7), 1998, pp. 37-51.

Cramton, C.D. "The Mutual Knowledge Problem and Its Consequences for Dispersed Collaboration," *Organization Science* (12:3), 2001, pp. 346-371.

Damsgaard, J., and Lyytinen, K. "Contours of Diffusion of Electronic Data Interchange in Finland: Overcoming Technological Barriers and Collaborating to Make it Happen," *Journal of Strategic Information Systems* (7), 1998, pp. 275-297.

Damsgaard, J., and Lyytinen, K. "The Role of Intermediating Institutions in the Diffusion of Electronic Data Interchange (EDI): How Industry Associations Intervened in Denmark, Finland, and Hong Kong," *Information Society* (17:3), 2001, pp. 195-210.

Das, T.K., and Rahman, N. "Opportunism Dynamics in Strategic Alliances," In *Cooperative Strategies and Alliances*, P.N. Ghauri (ed.) Pergamon, Boston, 2002, pp. 89-118.

Das, T.K., and Teng, B.S. "Instabilities of Strategic Alliances: An Internal Tensions Perspective," *Organization Science* (11:1), 2000, pp. 77-101.

Das, T.K., and Teng, B.S. "Trust, Control, and Risk in Strategic Alliances: An Integrated Framework," *Organization Studies* (22:2), 2001, pp. 251-283.

Das, T.K., and Teng, B.S. "Alliance Constellations: A Social Exchange Perspective," *Academy of Management. The Academy of Management Review* (27:3), 2002a, pp. 445-456.

Das, T.K., and Teng, B.S. "A Social Exchange Theory of Strategic Alliances," In *Cooperative Strategies and Alliances*, P. N. Ghauri (ed.) Pergamon, Boston, 2002b, pp. 439-460.

DiMaggio, P., and Powell, W. "The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields," *American Sociological Review* (48), 1983, pp. 147-160.

Duliba, K.A., Kauffman, R.J., and Lucas, H.C.J. "Appropriating Value from Computerized Reservation System Ownership in the Airline Industry," *Organization Science* (12:6), 2001, pp. 702-728.

Duncan, G.T., and Kaufman, S. "Who Should Manage Information and Privacy Conflicts?: Institutional Design for Third-Party Mechanisms," *The International Journal of Conflict Management* (7:1), 1996, pp. 21-44.

Dutta, N., and Kendall, J. "Exxon Mobil Integrates Information at Cerro Negro," *Oil & Gas Journal* (100:4), 2002, pp. 55-59.

El Sawy, O.A., Malhotra, A., Gosain, S., and Young, K.M. "IT-intensive Value Innovation in the Electronic Economy: Insights from Marshall Industries," *MIS Quarterly* (23:3), 1999, pp. 305-335.

Emmelhainz, M.A. "Strategic Issues of EDI Implementation," *Journal of Business Logistics* (9:2), 1988, pp. 55-70.

Farrell, C., and Song, J.H. "Strategic Uses of Information Technology," *S.A.M. Advanced Management Journal* (53:1), 1988, pp. 10-17.

Ford, D.P. "Trust and Knowledge Management: The Seeds of Success," In *Handbook on Knowledge Management: Knowledge Matters*, C. Holsapple (ed.) 1, Springer-Verlag, Berlin, 2003, pp. 553-576.

Forster, P.W., and Regan, A.C. "Electronic Integration in the Air Cargo Industry: An Information Processing Model of On-Time Performance," *Transportation Journal* (40:4), 2001, pp. 46-61.

Fredriksson, O., and Vilgon, M. "Evolution of the Inter-organizational Information Systems in Industrial Distribution: The Cases of Luna and Pappersgruppen," *European Journal of Information Systems* (5), 1996, pp. 47-61.

Gallaugher, J.M., and Wang, Y.M. "Understanding Network Effects in Software Markets: Evidence from Web-server Pricing," *MIS Quarterly* (26:4), 2002, pp. 303-327.

Gallupe, R.B., and Tan, F.B. "A Research Manifesto for Global Information Management," *Journal of Global Information Management* (7:3), 1999, pp. 5-18.

Golden, W., and Powell, P. "Exploring Inter-organizational Systems and Flexibility in Ireland: A Case of Two Value Chains," *International Journal of Agile Management Systems* (1:3), 1999, pp. 169-176.

Granovetter, M. "The Strength of Weak Ties," *American Journal of Sociology* (78), 1973, pp. 1360-80.

Grover, V., and Goslar, M. "Technical Correspondence," *Communications of the ACM* (36:3), March 1993, pp. 17.

Gulati, R. "Does Familiarity Breed Trust? The Implications of Repeated Ties for Contractual Choice in Alliances" *Academy of Management Journal* (38:1), 1995, pp. 85.

Gulati, R. "Alliances and Networks," *Strategic Management Journal* (19:4), 1998, pp. 293-317.

Gupta, A. "A Stakeholder Analysis Approach for Interorganizational Systems," *Industrial Management and Data Systems* (95:6), 1995, pp. 3-7.

Gurbaxani, V., and Whang, S. "The Impact of Information Systems on Organizations and Markets," *Communications of the ACM* (34:1), 1991, pp. 59-75.

Hansen, J.V., and Hill, N.C. "Control and Audit of Electronic Data Exchange," *MIS Quarterly*, December 1989, pp. 403-413.

Harold, J.E. "Evaluating and Implementing EDI at a Small Electronics Manufacturer," *Production and Inventory Management Journal*, 1997, pp. 1-5.

Hart, P.J., and Saunders, C.S. "Emerging Electronic Partnerships: Antecedents and Dimensions of EDI Use from the Supplier's Perspective," *Journal of Management Information Systems* (14:4), 1998, pp. 87-111.

Hauenstein, J., and Grupe, F.H. "Joint Partnerships: Washoe Health System Searches for Cutting-Edge Solutions," *Journal of Systems Management*, 1994, pp. 6-9.

Hendon, R.A., Nath, R., and Hendon, D.W. "The Strategic and Tactical Value of Electronic Data Interchange for Marketing Firms," *The Mid-Atlantic Journal of Business* (34:1), 1998, pp. 53-73.

Hitt, L.M. "Information Technology and Firm Boundaries: Evidence from Panel Data," *Information Systems Research* (10:2), 1999, pp. 134-149.

Holland, C.P., and Lockett, A.G. "Mixed Mode Network Structures: The Strategic Use of Electronic Communication by Organizations," *Organization Science* (8:5), 1997, pp. 475-488.

Hoogeweegen, M.R., Teunissen, W.J.M., Vervest, P.H.M., and Wagenaar, R.W. "Modular Network Design: Using Information and Communication Technology to Allocate Production Tasks in a Virtual Organization," *Decision Sciences* (30:4), 1999, pp. 1073-1103.

Huber, G.P. "A Theory Of The Effects Of Advanced Information Technologies," *Academy of Management Review* (15:1), 1990, pp. 47-73.

Iacovou, C.L., Benbasat, I., and Dexter, A.S. "Electronic Data Interchange and Small Organizations: Adoption and Impact of Technology," *MIS Quarterly* (19:4), 1995, pp. 465-486.

Jelassi, T., and Figon, O. "Competing Through EDI at Brun Passot: Achievements in France and Ambitions for the Single European Market," *MIS Quarterly*, 1994, pp. 337-352.

Jimenez-Martinez, J., and Polo-Redondo, Y. "International Diffusion of a New Tool: the Case of Electronic Data Interchange (EDI) in the Retailing Sector," *Research Policy* (26), 1998, pp. 811-827.

Johnston, H.R., and Vitale, M.R. "Creating Competitive Advantage with Interorganizational Information Systems," *MIS Quarterly* (12:2), 1988, pp. 153-165.

Jones, M., and Beatty, R.C. "User Satisfaction with EDI: An Empirical Investigation," *Information Resources Management Journal* (14:2), 2001, pp. 17-26.

Jun, M., Cai, S., and Peterson, R.T. "EDI Use and Participation Models: From the Inter-organizational Relationship Perspective," *Industrial Management and Data Systems* (100:9), 2000, pp. 412-420.

Karahannas, M.V., and Jones, M. "Interorganizational Systems and Trust in Strategic Alliances," *Proceedings of the ICIS*, 1999, pp. 346-357.

Kayworth, T.R., and Sambamurthy, V. "Facilitating Localized Exploitation and Enterprise-wide Integration in the Use of IT Infrastructures: The Role of PC/LAN Infrastructure Standards," *Database for Advances in Information Systems* (31:4), 2000, pp. 54-81.

Konsynski, B.R. "Strategic Control in the Extended Enterprise," *IBM Systems Journal* (32:1), 1993, pp. 111-142.

Konsynski, B.R., and McFarlan, F.W. "Information Partnerships - Shared Data, Shared Scale," *Harvard Business Review* (68:5), 1990, pp. 114-125.

Kumar, K., and van Dissel, H.G. "Sustainable Collaboration: Managing Conflict and Cooperation in Interorganizational Systems," *MIS Quarterly* (20:3), 1996, pp. 279-300.

Kumar, K., van Dissel, H.G., and Bielli, P. "The Merchant of Prato—Revisited: Toward a Third Rationality of Information Systems," *MIS Quarterly* (22:2), 1998, pp. 199-226.

Kumar, R., and Crook, C. "Educating Senior Management on the Strategic Benefits of Electronic Data Interchange," *Journal of Systems Management*, March/April 1996, pp. 42-47.

Kumar, R.L., and Crook, C. "A Multi-Disciplinary Framework for the Management of Interorganizational Systems," *Database for Advances in Information Systems* (30:1), 1999, pp. 22-37.

Lang, K.R., and Zhao, J.L. "The Role of Electronic Commerce in the Transformation of Distance Education," *Journal of Organizational Computing and Electronic Commerce* (10:2), 2000, pp. 103-127.

Lau, H.C.W., and Lee, W.B. "On a Responsive Supply Chain Information System," *International Journal of Physical Distribution & Logistics Management* (30:7/8), 2000, pp. 598-610.

Lee, H.G. "Do Electronic Marketplaces Lower the Price of Goods?," *Communications of the ACM* (41:1), 1998, pp. 73-80.

Lee, H.G., Clark, T., and Tam, K.Y. "Can EDI Benefit Adopters?," *Information Systems Research* (10:2), 1999, pp. 186-195.

Lewis, I., and Talalayevsky, A. "Third-Party Logistics: Leveraging Information Technology," *Journal of Business Logistics* (21:2), 2000, pp. 173-185.

Main, T.J., and Short, J.E. "Managing The Merger: Building Partnership Through IT Planning," *MIS Quarterly* (13:4), 1989, pp. 469-486.

Majchrzak, A., Rice, R.E., Malhotra, A., King, N., and Ba, S. "Technology Adaptation: The case Of A Computer-Supported Inter-Organizational Virtual Team," *MIS Quarterly* (24:4), 2000, pp. 569-600.

Malhotra, M.K., Heine, M.L., and Grover, V. "An Evaluation of the Relationship Between Management Practices and Computer Aided Design Technology," *Journal of Operations Management* (19:3), 2001, pp. 307-333.

Malone, T.W., Yates, J., and Benjamin, R.I. "Electronic Markets and Electronic Hierarchies," *Communications of the ACM* (30:6), 1987, pp. 484-497.

Maltz, E., and Srivastava, R.K. "Managing Retailer-Supplier Partnerships with EDI: Evaluation and Implementation," *Long Range Planning* (30:6), 1997, pp. 862-876.

Massetti, B., and Zmud, R.W. "Measuring the Extent of EDI Usage in Complex Organizations: Strategies and Illustrative Examples," *MIS Quarterly* (20:3), 1996, pp. 331-345.

Mata, F.J., Fuerst, W.L., and Barney, J.B. "Information Technology and Sustained Competitive Advantage: A Resource-based Analysis," *MIS Quarterly* (19:4), 1995, pp. 457-506.

McFarlan, F.W. "Information Technology Changes the Way You Compete," *Harvard Business Review* (62:3), 1984, pp. 98-103.

McLaren, T.S. "Usability of Supply Chain Collaboration Systems: An Extended Abstract," *Proceedings of the 3rd World Congress on the Management* *of Electronic Commerce*, Hamilton, ON, 2002.

Monge, P.R., Fulk, J., Kalman, M.E., and Flanagin, A.J. "Production of Collective Action in Alliance-based Interorganizational Communication and Information Systems," *Organization Science* (9:3), 1998, pp. 411-433.

Mukhopadhyay, T., Kekre, S., and Kalathur, S. "Business Value of Information Technology: A Study of Electronic Data Interchange," *MIS Quarterly*, 1995, pp. 137-156.

Murphy, P.R., and Daley, J.M. "EDI Benefits and Barriers Comparing International Freight Forwarders and their Customers," *International Journal of Physical Distribution & Logistics Management* (29:3), 1999, pp. 207-216.

Narayandas, D., Caravella, M., and Deighton;, J. "The Impact of Internet Exchanges on Business-to-Business Distribution," *Journal of the Academy of Marketing Science* (30:4), 2002, pp. 500-505.

Neo, B.S. "Managing New Information Technologies: Lessons from Singapore's Experience With EDI," *Information & Management* (26:6), 1994, pp. 317-326.

Nidumolu, S.R. "Interorganizational Information Systems and the Structure and Climate of Seller-Buyer Relationships," *Information & Management* (28), 1995, pp. 89-105.

Oliver, C. "Network Relations and Loss of Organizational Autonomy," *Human Relations* (44:9), 1991, pp. 943-962.

Payton, F.C. "Lessons Learned From Three Interorganizational Health Care Information Systems," *Information & Management* (37:6), 2000, pp. 311-321.

Payton, F.C., and Ginzberg, M.J. "Interorganizational Health Care Systems Implementations: An Exploratory Study of Early Electronic Commerce Initiatives," *Health Care Management Review* (26:2), 2001, pp. 20-32.

Pfeffer, J., and Salancik, G.R. *The External Control of Organizations*, Harper Collins, New York, 1978.

Premkumar, G., and Ramamurthy, K. "The Role of Interorganizational and Organizational Factors on the Decision Mode for Adoption of Interorganizational Systems," *Decision Sciences* (26:3), 1995, pp. 303-336.

Premkumar, G., Ramamurthy, K., and Nilakanta, S. "Implementation of Electronic Data Interchange: An Innovation Diffusion Perspective," *Journal of Management Information Systems* (11:2), 1994, pp. 157-186.

"The Possible Dream," *Professional Engineering*, December 2001.

Quinn, R.E. "The Impacts of a Computerized Information System on the Integration and Coordination of Human Services," *Public Administration Review* (36:2), March/April 1976, pp. 166.

Raghunathan, S. "Interorganizational Collaborative Forecasting and Replenishment Systems and Supply Chain Implications," *Decision Sciences* (30:4), 1999, pp. 1053-1071.

Raghunathan, S., and Yeh, A.B. "Beyond EDI: Impact of Continuous Replenishment Program (CRP) Between a Manufacturer and its Retailers," *Information Systems Research* (12:4), 2001, pp. 406-419.

Riggins, F.J., and Mukhopadhyay, T. "Interdependent Benefits from Interorganizational Systems: Opportunities for Business Partner Reengineering,"

Journal of Management Information Systems (11:2), 1994, pp. 37-57.

Riggins, F.J., and Rhee, H.-S. "Toward a Unified View of Electronic Commerce," *Communications of the ACM* (41:10), 1998, pp. 88-95.

Rockart, J.F., and Short, J.E. "IT In The 1990s: Managing Organizational Interdependence," *Sloan Management Review* (30:2), Winter 1989, pp. 7-18.

Rode, D. "Patient Accounts and MIS: Facing the Future Together," *Healthcare Financial Management* (47:4), 1993, pp. 90-91.

Rosenthal, R., Shah, S.K., and Xiao, B. "The Impact of Purchasing Policy on Electronic Markets and Electronic Hierarchies," *Information & Management* (25), 1993, pp. 105-117.

Rule, E., and Keown, S. "Competencies of High-Performing Strategic Alliances," *Strategy & Leadership*, 1998, pp. 36-37.

Sarkar, M.B., Butler, B., and Steinfield, C. "Intermediaries and Cybermediaries: A Continuing Role for Mediating Players in the Electronic Marketplace," *Journal of Computer Mediated Communication* (1:3), 1996.

Schermerhorn, J.R. "Information Sharing as an Interorganizational Activity," *Academy of Management Journal* (20:1), 1977, pp. 148-153.

Scott, J.E. "Facilitating Interorganizational Learning with Information Technology," *Journal of Management Information Systems* (17:2), 2000, pp. 81-113.

Segev, A., Porra, J., and Roldan, M. "Internet-based EDI Strategy," *Decision Support Systems* (21), 1997, pp. 157-170.

Shah, R., Goldstein, S.M., and Ward, P.T. "Aligning Supply Chain Management Characteristics and Interorganizational Information System Types: An Exploratory Study," *IEEE Transactions on Engineering Management* (49:3), 2002, pp. 282-292.

Song, L., and Nagi, R. "Design and Implementation of a Virtual Information System for Agile Manufacturing," *IEEEE Transactions* (29), 1997, pp. 839-857.

Spanos, Y.E., Prastacos, G.P., and Poulymenakou;, A. "The Relationship Between Information and Communication Technologies Adoption and Management," *Information & Management* (39:8), 2002, pp. 659-675.

Stock, G.N., Gries, N.P., and Kasarda, J.D. "Enterprise Logistics and Supply Chain Structure: The Role of Fit," *Journal of Operations Management* (18:5), 2000, pp. 531-547.

Strader, T.J., and Shaw, M.J. "Characteristics of Electronic Markets," *Decision Support Systems* (21), 1997, pp. 185-198.

Suomi, R. "Inter-Organizational Information Systems as Company Resources," *Information & Management* (15), 1988, pp. 105-112.

Suomi, R. "What to Take Into Account When Building an Inter-Organizational Information System," *Information Processing and Management* (30:1), 1994, pp. 151-159.

Suter, B. "VEGA*: Co-operation Platform for Virtual Enterprises," *Proceedings of the Distributed Working - Work of the Future*, Stuttgart, 2000.

Suzuki, Y., and Williams, L.R. "Analysis of EDI Resistance Behavior," *Transportation Journal*, 1998, pp. 36-44.

Teo, H.-H., Tan, B.C.Y., and Wei, K., Kee "Organizational Transformation

Using Electronic Data Interchange: The Case of TradeNet in Singapore," *Journal of Management Information Systems* (13:4), 1997, pp. 139-165.

Teo, H.-H., Wei, K., Kee, and Benbasat, I. "Predicting Intention To Adopt Interorganizational Linkages: An Institutional Perspective," *MIS Quarterly* (27:1), 2003, pp. 19-49.

Thompson, J.D. *Organizations in Action: Social Science Bases of Administrative Theory*, McGraw-Hill, New York, 1967.

Tiwana, A., and Ramesh, B. "A Design Knowledge Management System to Support Collaborative Information Product Evolution," *Decision Support Systems* (31:2), 2001, pp. 241-262.

Truman, G.E. "Integration in Electronic Exchange Environments," *Journal of Management Information Systems* (17:1), 2000, pp. 209-244.

Turoff, M., Hiltz, S.R., Bahgat, A.N.F., and Rana, A.R. "Distributed Group Support Systems," *MIS Quarterly*, 1993, pp. 399-417.

Venkatraman, N. "Five Steps to a Dot-Com Strategy: How to Find Your Footing on the Web," *Sloan Management Review* (41:3), 2000, pp. 15-28.

Venkatraman, N., and Henderson, J.C. "Real Strategies for Virtual Organizing," *Sloan Management Review*, 1998, pp. 33-48.

Vijayasarathy, L.R., and Tyler, M.L. "Adoption Factors and Electronic Data Interchange Use: A Survey of Retail Companies," *International Journal of Retail & Distribution Management* (25:9), 1997, pp. 286-292.

Vlosky, R.P., Smith, P.M., and Wilson, D.T. "Electronic Data Interchange Implementation Strategies: A Case Study," *Journal of Business & Industrial Marketing* (9:4), 1994, pp. 5-18.

Walton, L.W., and Miller, L.G. "Moving Toward LIS Theory Development: A Framework of Technology Adoption Within Channels," *Journal of Business Logistics* (16:2), 1995, pp. 117-135.

Wang, E.T., and Seidmann, A. "Electronic Data Interchange: Competitive Externalities and Strategic Implementation Policies," *Management Science* (41:3), 1995, pp. 401-418.

Wang, S. "Meta-management of Virtual Organizations: Toward Information Technology Support," *Internet Research: Electronic Networking Applications and Policy* (10:5), 2000, pp. 451-458.

Webster, J., and Watson, R.T. "Analyzing the Past to Prepare for the Future: Writing a Literature Review," *MIS Quarterly* (26:2), June 2002, pp. 13-24.

Weick, K.E. "Educational Organizations As Loosely Coupled Systems," *Administrative Science Quarterly* (21:1), March 1976, pp. 1.

Williams, L.R. "Understanding Distribution Channels: An Interorganizational Study of EDI Adoption," *Journal of Business Logistics* (15:2), 1994, pp. 173-203.

Wilson, D.T., and Vlosky, R.P. "Interorganizational Information System Technology and Buyer-Seller Relationships," *Journal of Business & Industrial Marketing* (13:3), 1998, pp. 215-234.

Wilson, E.O. *Naturalist*, Island Press, 1994.

Zeffane, R. "Inter-organizational Alliance and Networking: Dynamics, Processes and Technology?" *Leadership & Organization Development Journal* (15:7), 1994, pp. 28-33.

Appendix A

Table 3. Literature Review Results

Article	IOS Type[6]	Management Challenges/ Relationship Risks	IOS Characteristics	Management Considerations
("The Possible Dream", *Professional Engineering*)	MP	Using IOS to manage partner replacement in a post-disaster environment	Automobile supply-chain	Risk
(Bakos 1991)	MP	Understanding who benefits most in an E-market: the buyer or the seller	E-market	Change, benefit differences
(Barua & Lee 1997)	MP	Use of penalties to coerce a supplier to adopt a EDI system can end up hurting both the manufacturer and the supplier	EDI - manufacturer	Power and benefit differences, user adoption
(Benaroch & Kauffman 2000)	MP	Managing expectations of potential partners is critical. When network effects are present, first adopters tend to pay higher costs until more partners adopt the IOS; incentive for adopters to wait.	POS Debit service from banks	Network effects
(Chatfield & Bjorn-Andersen 1997)	MP	Challenges relate to ensuring information is available and accurate, or agents may switch IOS. Responding to IOS user requirements.	Airline reservation system, single company has multiple IOS types, each with different management challenges	Dependency-based power flows both ways?

[6] modular sequential (MS); modular pooled (MP); reciprocal sequential (RS); reciprocal pooled (RP)

Article	IOS Type[6]	Management Challenges/ Relationship Risks	IOS Characteristics	Management Considerations
(Chatfield & Yetton 2000)	MP	Achieving a high degree of embeddedness (also high trust) to maximize benefits of EDI implementation	EDI-government, airline; automotive	Network effects, user adoption
(Chen & Sheldon 1997)	MP	Managing multiple stakeholders with heterogeneous needs	Destination IS (public CRS info)	Multiple stakeholders
(Chircu & Kauffman 2000)	MP	Managing differences in system usability, resource availability, existing but incompatible contracts and company-specific processes are important to getting partners to adopt a new IOS	Internet-based reservation systems	Network Effects
(Chircu et al. 2001)	MP	Benefits of owning or using web-based reservation systems increase as more organizations use them. Challenge is in maintaining profitable usage levels.	Web-based travel reservation system	Network effects
(Chismar & Meier 1992)	MP	Managing dependencies: Threat of IOS substitutes places more power in the hands of IOS users, but as number of users increases, power shifts in favor of IOS owners	Airline reservation system	Network effects
(Choudhury et al., 1998)	MP	Balancing the risks of purchasing sight unseen with need for speed	E-market airlines inventory locator system	Trust
(Choudhury et al. 1998)	MP	Identifying and selecting partners in an E-market	E-market, aircraft parts	Power and benefit differences

Article	IOS Type[6]	Management Challenges/ Relationship Risks	IOS Characteristics	Management Considerations
(Christiaanse & Venkatraman 2002)	MP	Managing power and dependence shifts: as organizations become more dependent on each other's data, benefits evolve from owning the infrastructure to owning the ability to filter process the data (EVA).	Airline reservation DSS – SMARTS, technology ownership benefits attenuated by specific skill ownership	Power & benefit differences
(Cox & Ghoneim 1998)	MP	Need to be aware of industry sector, position in the sector, marketplace dynamics and own strengths to gain competitive advantage	EDI - government	Process, change
(Damsgaard & Lyytinen 2001)	MP	Resource ownership and the development of a technical standard.	E-market, electronic trading	Power & benefit differences
(Duliba et al. 2001)	MP	Managing power differences and dependencies: Once IOS use increases past a critical point, IOS owners can leverage the user's dependencies to gain even more economic benefit	CRS	Power & benefit differences
(Duncan & Kaufman 1996)	MP	Information privacy concerns are important in centralized data service management. Three stakeholders involved, data providers, users, and the IO itself. Ownership, control, stewardship, and privacy issues.	Information Organization context (census bureaus, health data providers, credit bureaus)	Heterogeneous stakeholdersPrivacy
(El Sawy et al. 1999)	MP	Finding new ways to create value when much E-market and EDI value is captured by the customer	EDI - industrial electronics	Power & benefit differences

Article	IOS Type[6]	Management Challenges/ Relationship Risks	IOS Characteristics	Management Considerations
(Emmelhainz 1988)	MP	Managing the implementation of an EDI to maximize benefits and minimize disruption	EDI-multi-industry	User adoption, user participation
(Farrell & Song 1988)	MP	Maximizing benefits to the firm and customers through aggressive adoption and use of IT	AHSC and SABRE	Process, change
(Fredriksson & Vilgon 1996)	MP	Managing the evolution of an IOS	Supply-chain management	Growth and technological change
(Golden & Powell 1999)	MP	IOS can provide operational flexibility, but only when technologies do not conflict. Technology considerations can create relationship management considerations – when technologies conflict, who changes? IOS networks are increasing difficult to manage technically as more partners join, but have different technologies (harmful network effects?)	EDI in buyer-supplier relationships, technology standards use attenuates effects of differences	Network effects
(Hansen & Hill 1989)	MP	Adjusting control and audit methods and procedures so that they remain effective in an EDI environment	EDI - survey	Process, risk
(Iacovou et al. 1995)	MP	Interorganizational management challenges involve power differences, size differences, and sharing of benefits.	Small-business suppliers to government	Power & benefit differences
(Jelassi & Figon 1994)	MP	Using IT to gain a competitive advantage through capabilities gained through early adoption of new technologies	EDI - office supplies	Growth and technological change

Article	IOS Type[6]	Management Challenges/ Relationship Risks	IOS Characteristics	Management Considerations
(Jimenez-Martinez & Polo-Redondo 1998)	MP	Managing system growth and user adoption without significant market power	EDI - retail	User adoption, power differences
(Jones & Beatty 2001)	MP	Aligning the EDI with the needs of suppliers to achieve higher system usage	EDI - manufacturing	Benefit differences, fit with organizational culture and processes
(Jun et al. 2000)	MP	Extending the reach of an EDI to include SMEs. Lack of readiness and unique perspective of SMEs inhibits adoption.	EDI - manufacturing	User adoption
(Kumar & Crook 1999)	MP	Organizations with only a few partners view IOS infrastructure as a specific asset; transaction costs were tolerable when transaction volume was sufficiently high; power not evenly distributed through supply chain; benefits not evenly realized – created partner risk & management challenge; larger companies had advantage; Managers must balance individual, technical, and organizational factors.	Industry standards important	Power & benefit differences
(Kumar & van Dissel 1996)	MP	Low risk for partner conflict, management concerns are establishing standards and rules	Low risk relationship	
(Lang & Zhao 2000)	MP	Managing information content, system growth, user adoption are essential.	E-learning, distributed distance education	User adoptionGrowth

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(Lee 1998)	MP	Reduced search costs for buyers leads to expectations of lower prices. More buyers may actually increase product cost.	Used car auction system	Process
(Lee, et al. 1999)	MP	Coordinating channel inventory with poor information thus misguiding channel partners	EDI-retail	Power & benefit differences
(Neo 1994)	MP	The implementation of new technologies requires careful and complete planning	EDI - government	User adoption
(Nidumolu 1995)	MP	IOS use by agents increases percentage of business to IOS supplier, but decision centralization not an issue. Sufficiently high levels of mutual gain appear to occur. IOS participants do not always feel 'locked-in'. Power differences not as much of an issue.	IOS use by agents led to increased transactions and more positive climate	Dependency-based power flows both ways?
(Premkumar & Ramamurthy 1995)	MP	Exercising power over channel to set standards, ensure adoption, and improve performance	EDI, automobile, retail	User adoption, power dependence
(Riggins & Mukhopadhyay 1994)	MP	Challenge of managing unequal, but interdependent, benefits (unequal because of transaction size differences relative to total business size)	MS because, in dyads, only 1 partner, in MP the presence of n partners creates network effects, which are missing in MS	Unequal, but interdependent, relationship
(Rode 1993)	MP	Using EDI to respond to environmental change and to effect organizational change.	EDI-healthcare	Process, change

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(Rosenthal et al. 1993)	MP	Adjusting purchasing policies to take advantage of e-markets	E-markets	Process, growth
(Segev et al. 1997)	MP	Choosing the appropriate form for developing an Internet-based EDI	Pharmaceutical wholesaler, bank	Process, change
(Strader & Shaw 1997)	MP	The cost based differences between traditional and E-markets affects industry structure and future sources of organizational revenue	E-market	Process, benefit differences
(Suomi 1988)	MP	Demonstrating value to justify costs hard to do. Partners demand for information expensive to meet.	Insurance company to major customers	Risk, cost
(Suomi 1994)	MP	Change in corporate culture and management actions necessitated by an IOS	Insurance company	Power & benefit differences
(Teo et al. 1997)	MP	Using EDI to generate gains, in organizational effectiveness and efficiency	Trade Net, Singapore based government EDI	Change
(Teo et al. 2003)	MP	Institutional pressures exert a strong influence on the intent to adopt an IOS	User adoption	
(Venkatraman & Henderson 1998)	MP	Adding value while controlling costs in a retailer-customer EDI environment	EDI - retailing	
(Vijayasarathy & Tyler 1997)	MP	Demonstrating value and lower cost critical to acceptance and use. Management challenge is in controlling and lowering transaction costs.	Retail industry, adoption reasons primarily economic; partners used direct lines & used 3rd	Power & benefit differences

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			party networks; most used industry standards	Power & benefit differences
(Vlosky et al. 1994)	MP	Managing power and mutual benefit imbalances: Buyers have power and leverage over suppliers	Home center retailers	Power & benefit differences
(Wang & Seidmann 1995)	MP	Buyers in a buyer-supplier EDI relationship often gain more benefits than suppliers; buyers should subsidize supplier costs when appropriate		Power & benefit differences
(Wilson & Vlosky 1998)	MP	Significant management considerations are inter-partner trust, commitment, satisfaction, and power/dependency differences		Power & benefit differencesTrust
(Wilson & Vlosky 1998)	MP	Non-alignment of exchange partner expectations and perceptions within relationships	EDI, large retailers	Power & benefit differences
(Au & Kauffman 2001)	MS	Managing mutual benefits and dependencies is important. Network effects make adoption more attractive and technological compatibility more important. Important to manage the whole process without being domineering, as all parties must be present for system to be of value.	Electronic bill payment context – three IOS stakeholders, banks, consolidators, & billers	Power & benefit differences

Article	IOS Type[6]	Management Challenges/ Relationship Risks	IOS Characteristics	Management Considerations
(Basu & Kumar 2002)	MS	Need for standards. Problems with who controls which elements of process.	Sequential workflow across multiple organizations	Power differences, sharing information
(Benasou 1997)	MS	Buyer-supplier dyads; the higher the environmental uncertainty and longer the partnership horizon, the higher the levels of cooperation	Uncertain & interconnected environment, mutual success requires cooperation	Interdependencies
(Chatfield & Bjorn-Andersen 1997)	MS	Management challenges involve coordination of information between partners, singly responsible but jointly at risk	Supply-chain EDI system linking procurement, airline, delivery, outsourcing functions – air travel process	Individually responsible, but jointly at risk
(Chwelos et al. 2001)	MS	Interdependencies, power differences, individual adoption responsibilities	EDI in corporate purchasing context	Individually responsible, but jointly at risk
(Kumar & van Dissel 1996)	MS	Moderate risk for partner conflict; management concerns are establishing standards, governance, schedules, and plans.		
(Arunachalam 1997)	RP	Understanding the factors in EDI adoption which led to previous successes so that greater benefits can be extracted from EDI use	EDI-multi-industry	User adoption, process
(Bakos & Nault 1997)	RP	Viability an IOS depending on who owns it. Ownership should be jointly held by all indispensable participants.	Industry-wide IOS	IOS costs, power & benefit differences

Article	IOS Type[6]	Management Challenges/ Relationship Risks	IOS Characteristics	Management Considerations
(Bellamy & Taylor 1996)	RP	Access, sharing, and control of different information sources making up the shared pool create difficulties related to managing power differences, multiple stakeholders, and ensuring fairness and mutual benefits (‘information politics’) (similar to KM lit regarding information sharing barriers)	Multi-divisional governmental system	Resource ownershipMultiple heterogeneous stakeholders
(Benasou & Venkatraman 1996)	RP	Achieving fit between interorganizational information processing needs and information processing capabilities	Generic	Process and trust
(Bergeron & Raymond 1997)	RP	Understanding the benefits, necessary conditions of and impact of time on EDI	EDI-survey	Power & benefit differences
(Chen & Williams 1998)	RP	Managing EDI implementation in SMEs	EDIs - 4 manufacturing and 4 retailing	Power & benefit differences
(Ching et al. 1996)	RP	What kind of IT support is needed to best exploit the IOS?	EDI - manufacturing	Balancing system capability and cost
(Cramton 2001)	RP	Five management challenges related to dispersed collaboration: failure to communicate and retain contextual information; unevenly distributed information; difficulty communicating and understanding information salience; differences in speed of access to information; difficulty interpreting the meaning of silence.(difficulties of knowing something but not being there)	Management challenges were discussed as ‘mutual knowledge’ problems	Managing mutual knowledge

Article	IOS Type[6]	Management Challenges/ Relationship Risks	IOS Characteristics	Management Considerations
(Damsgaard & Lyytinen 1998)	RP	Dealing with interplay of organizational, industry and institutional factors	Multiple case study of EDI	Network effects
(Gupta 1995)	RP	Using a stakeholder approach to craft an IOS strategy	Generic example	Heterogeneous stakeholders
(Harold 1997)	RP	Implementing a new EDI	EDI - small electronics manufacturer	Process, cost
(Hauenstein & Grupe 1994)	RP	Cooperative IOS development to reduce risk and costs	Health information	User participation, dependence
(Hendon et al. 1998)	RP	Taking a hard line with suppliers. If you are not on our EDI you don’t do business with us.	EDI - large retailers	Process, standards, compatibility
(Karahannas & Jones 1999)	RP	Interorganizational trust	Dyadic. Not email	Power and trust
(Kumar & Crook 1996)	RP	Educating senior management as to the full potential of EDI	EDI-multi-industry	User adoption, cost
(Kumar et al. 1998)	RP	Perceived marginal value fragmentation of the network into specialized segments	Knowledge sharing system in the textile industry	Network effects, cost
(Majchrzak et al. 2000)	RP	Effective IOS management must be aware of barriers to adding, being made aware of, and acting on, shared knowledge in the absence of co-location.	KMS portion of IOS	Managing mutual knowledge
(McFarlan 1984)	RP	Using EDI to gain competitive advantage	EDI - multiple case studies	Process

Article	IOS Type[6]	Management Challenges/ Relationship Risks	IOS Characteristics	Management Considerations
(Monge et al. 1998)	RP	The use of an IOS in an alliance produces information, public goods as a by product thus there is leakage	SEMATECH- semiconductor manufacturers alliance	Privacy
(Murphy & Daley 1999)	RP	Understanding the benefits of and barriers to EDI use from both the suppliers and the buyers perspective is essential to success in this industry	EDI - international freight forwarders	User adoption
(Payton & Ginzberg 2001)	RP	Management of trust, power, and political differences between multiple stakeholders is critical. System use not guaranteed.	CHIN	Multiple stakeholdersTrust
(Payton 2000)	RP	Managing multiple stakeholders with heterogeneous needs, political forces, & institutional differences. Privacy concerns.	Health care IOS, multiple parties, multiple views & needs	Multiple heterogeneous stakeholdersPrivacy
(Premkumar & Ramamurthy 1995)	RP	Firms which proactively adopt EDI have greater external connectivity and better integration of EDI in their internal systems	EDI - 201 firms surveyed	Power, user adoption
(Premkumar et al. 1994)	RP	Considering EDI adoption as a diffusion of innovation issue	Same data set as #53	User adoption
(Quinn 1976)	RP	The implementation of an IOS in a public organization can be problematic due to threats to autonomy and competition for resources	Government-health	User adoption, power
(Rule & Keown 1998)	RP	High-performing alliances (top 10%) always have excellent communication and information sharing through IOSs	All forms	Dependency trust

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(Sarkar et al. 1996)	RP	Replacing the functions of the intermediary in an E-Market	E-market	Power & benefit differences
(Schermerhorm Jr. 1977)	RP	The presence of slack is an essential prerequisite to the establishment of interorganizational relationships	Information sharing in health care	Process
(Stock et al. 2000)	RP	Aligning the system with the needs of the extended enterprise	Globally dispersed supply-chain	System fit
(Sutter 2000)	RP	Remaining competitive as an SME through establishing virtual organizations using IOSs	Vega	Network effects
(Suzuki & Williams 1998)	RP	Managing resistance to EDI adoption	Shipper - carrier	User adoption
(Truman 2000)	RP	How to effectively integrate EDI with internal systems	EDI- group insurance	Risk
(Turoff et al. 1993)	RP	Supporting decision making for a geographically distributed group using IT	DGSS	Design, technology
(Zeffane 1994)	RP	Using IOS to speed the development and deployment of new products	EDI-multiple case studies	Network effects
(Alt et al. 2000)	RS	Combining electronic commerce and supply chain management in a single IOS	Swatch	Process, network effects
(Benjamin & Wigand 1995)	RS	Managing the change in channels as electronic markets develop	E-market, industry value chains	Power & benefit differences

Article	IOS Type[6]	Management Challenges/ Relationship Risks	IOS Characteristics	Management Considerations
(Braunstein 1999)	RS	Sharing information properly, system training, and process change management is important because partners are tightly interconnected	Allows much shorter time-to-market	Process managementInformation exchange
(Clemons & Kleindorfer 1992)	RS	Understanding the economics of buyer-supplier interactions which use interorganizational IT	ATM network, airline reservation system	Power & benefit differences
(Dutta & Kendall 2002)	RS	System design and implementation takes considerable effort, possibly best undertaken by a single, possibly dominant, partner.	Oil industry – embedded process is oil refinery	Process management
(Forster & Regan 2001)	RS	Relationships in the supply chain can negatively impact the performance benefits of EDI adoption and integration	EDI- air cargo	Power
(Hart & Saunders 1998)	RS	Easier exchange of information does not necessarily mean more frequent or better exchange	EDI - manufacturing	Power and trust, dependence
(Hoogeweegen et al. 1999)	RS	Assignment of production tasks among members of a virtual organization	Modular network design - air cargo example	Process
(Kumar & van Dissel 1996)	RS	Strategies for minimizing the conflicts likely to arise in a supply-chain IOS	Multiple examples	Risk, power and benefit differences
(Lau & Lee 2000)	RS	Accuracy and relevance of the information provided by the information system	Supply-chain info system	Process, mutual knowledge
(Majchrzak et al. 2000)	RS	Must ensure the embedded process follows embedded practice or usage levels will drop.	Workflow portion of system did not reflect actual practice and was not used.	Process management

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(Malhotra et al. 2001)	RS	Effective use of an IOS by a virtual team in a product development initiative	Shared CAD CAM	Process
(Maltz & Srivastava 1997)	RS	Evaluating the effectiveness of EDI systems	EDI-retail	Risk, value
(McLaren 2002)	RS	Managing information content, planning for future use and new partners	Supply-chain collaboration	User acceptance, user adoption
(Mukhopadhyay et al. 1995)	RS	Using EDI to reduce production costs and documenting those benefits	EDI- Chrysler	Process
(Raghunathan & Yeh 2001)	RS	Managing mutual benefits, process differences	Continuous replenishment program (CRP), retail-supplier	Process Management
(Raghunathan 1999)	RS	Overall benefits increase as more partners take part. As supplier numbers increase, there is more incentive for individual suppliers to join – buyer's advantage		Power & benefit differencesNetwork effects
(Riggins & Rhee 1998)	RS	Managing business relationships in the face of change brought on by implementation of an IOS	E-commerce, extranet	Process, change
(Rockart & Short 1989)	RS	Understanding the impact of technology on the organization	Technology-enabled value-added chains	Process, change

Article	IOS Type[6]	Management Challenges/ Relationship Risks	IOS Characteristics	Management Considerations
(Scott 2000)	RS	Effective interorganizational collaboration requires high degrees of trust.	Highly complex product development. IOS structures facilitated learning (Cohen & Levinthal 1989)	Trust
(Shah et al. 2002)	RS	Alignment of the IOS with the needs of the supply-chain- members	Supply-chain manufacturing	Power & benefit differences
(Song & Nagi 1997)	RS	Management challenges are in maintaining proper information exchange and information consistency. (When individual partners own their own data/HW/SW, they have individual responsibilities to maintain exchanges and consistency, but everyone shares risk.)	Joint design and manufacturing setting	Individual responsibility, but joint risk
(Tiwana & Ramesh 2001)	RS	Managing the routing or process directions, especially under deadlines, is potentially troublesome. Elaborating and refining ideas requires proper mutually-understood structure, particularly in a semi-structured environment (newspaper publishing).	Two partners (dyad). System is described as a KMS	Process managementMutual knowledge
(Walton & Miller 1995)	RS	Understanding interorganizational technology adoption to achieve better supply chain management.	EDI - supply chain	User adoption
(Williams 1994)	RS	The effective coordination and maintenance of interorganizational exchange relationships in channels.	EDI - supply chain	User adoption