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Understanding the Diversity of Interconnections between IS: Towards a New Typology of IOS

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UNDERSTANDING THE DIVERSITY OF INTERCONNECTIONS BETWEEN IS: TOWARDS A NEW TYPOLOGY OF IOS

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Abstract

Electronic exchanges of information between Businesses have continued to grow over recent decades. Though the emergence of new technologies, firms are facing new opportunities to build Interorganizational Information Systems (IOSs) to organize electronic data exchanges to update their own information systems. In this paper, we focus on flows from suppliers to retailers of product information, a set of data that describe the product manufactured by suppliers and retailed by wholesalers to the end consumer. We propose a new methodology to analyze IOSs, by considering how suppliers build their sending systems, how retailers build their receiving systems and how their interconnections lead to the creation of IOSs. Through a qualitative research based on interviews and documentation reviews, we describe and discuss the possibilities of interconnections between sending and receiving systems based on data privacy, structural linkages and message interdependencies.

Keywords: Interorganizational Information Systems, typology, sending systems, receiving systems, interconnection, Product information management.

INTRODUCTION

Electronic exchanges of information between Businesses have continued to grow over recent decades. Electronic Data Interchange (EDI) is a well-known example of Interorganizational Information System (IOS) in B2B exchanges (Barrett and Konsynski, 1982, Damsgard and Truex, 2000). Nowadays, the Internet offers new opportunities to develop other types of IOSs in order to exchange data electronically (Zhu et al., 2006). In the past, companies were mostly concerned with the decision regarding whether to adopt a special IOS, that has predefined characteristics for both senders and receivers. Considering the evolution towards new technologies providing more flexible opportunities for electronic interconnection, companies are nowadays more concerned with how and to what extent they can interconnect with their partners systems that have been designed differently. In this context, our research question aims at understanding how different types of sending and receiving systems can be interconnected, thus leading to different forms of IOSs? Therefore, the objective of this paper is to propose a new framework to analyze IOSs following two steps: the first one is about the description of the systems senders build to communicate with receivers and receivers build to communicate with senders; the second step is to analyze interconnections between these sending and receiving systems. This framework allows to extract forms of IOSs, issued from interconnections of sending and receiving systems, that are different from market and hierarchical forms (Bakos, 1991). The question of existence, stability and value of these forms of IOSs is a major practical and theoretical contribution of this paper.

Behind the theoretical development of such a typology of IOSs, our second objective is to find empirical evidence of different types of IOSs coexisting for a given process. Whereas most literature on IOS only examines the relatively structured flow of information about transactions (e.g., sales or purchases), we investigate the much less structured flow of product information between manufacturers and retailers. Product information is defined as a set of data that represents the identifying, technical, logistical and marketing characteristics of a product (Legner and Schemm, 2008). Product information pushes the technical frontier of electronic data exchanges because it contains unstructured information, dimensional information and relatively invariable information (e.g., product descriptions) as well as variable information, which may be unique to each partner who purchases the product (e.g., price and delivery terms). Over the last ten years, large retail industry has developed standards and technologies to exchange product information from manufacturer’s to retailer’s internal databases through the use of electronic catalogues. We define these as electronic data pools that contain data describing articles (Nakatani et al., 2006; Legner and Schemm, 2008). Electronic catalogues are designed to support push data flows from manufacturers to retailers. Considering these characteristics, we hypothesize that several types of IOSs could emerge to support the specific process of interorganizational product information management by synchronizing data, in as close to real time as possible, between the internal databases of manufacturers and retailers.

After reviewing the relevant literature on IOS, we develop several propositions regarding messages sent, messages received and the possibilities for interconnection between sending and receiving systems. We then describe the methodology, the results and discuss the findings and their implication, before conclusion.

1 RESEARCH FRAMEWORK

1.1 IOS concepts and Typologies

Several definitions of IOS can be found in the literature and all have at least the following components (Suomi, 1992, p94): “*sharing of data or other resources; two or more organizations; IOSs are based on* *computers*". We focus on types of IOSs that are designed to automate push data flows from company to company. With this automation perspective, no human intervention is needed (Suomi, 1992). However, automation can not be achieved without standardization. IOS standards are defined as "*a set of technical specifications that are agreed upon and used by IOS developers to describe data formats and communication protocols, which enable computer-to-computer communications*" (Zhu et al., 2006). In the literature dealing with standards, two major forms of standards appear (Markus et al., 2006). In the first case, a company can impose its proprietary standard on its partners. Alternatively, industry or global standards are standards that are shared by all the companies in a sector.

To rephrase, we are focusing on types of IOSs supporting forms of electronic data exchanges designed to integrate data in standardized messages from the sender's to the receiver's internal database. The Internet and the development of electronic intermediaries are considered to be new opportunities for doing electronic data exchanges. Whereas traditional EDI implies data integration between two companies (Elgarah et al., 2005), new forms of electronic data exchanges propose more centralized data integration, where data pools can integrate data from a large number of firms. Previous research has shown that EDI allows the external integration of data (Swatman and Swatman, 1991), from the boundaries of a company to the boundaries of another one. Moreover, companies can maximize benefits brought from EDI adoption and use when they also achieve data integration with their own internal IS (Truman, 2000; Mukhopadhyay and Kekre, 2002). Electronic catalogues are thought as IT that firms can implement in order to achieve both internal integration and external integration (Nakatani et al., 2006). So we do not consider only data transmission between two systems, but also data emission from internal sender database and data reception by receiver internal database (Figure 1).

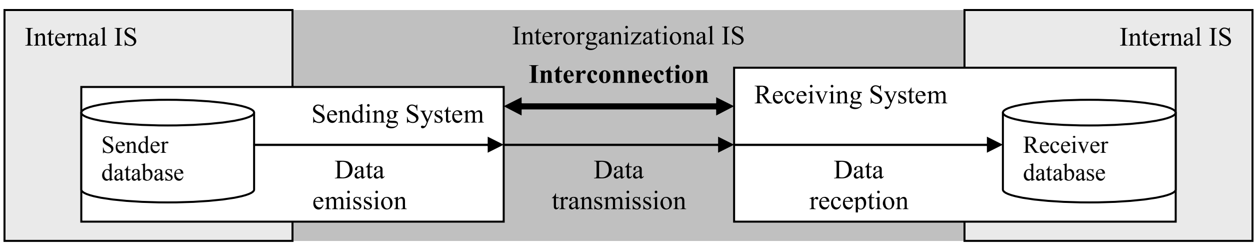


Figure 1. Data flows for interconnection

Though based on different theoretical backgrounds (Elgarah et al., 2005), IOS typologies are all derived from the concept of electronic interconnection. Indeed, IOS implementation means electronic interconnection between organizations in order to coordinate their data exchanges. From the electronic interconnection perspective, we present IOS typologies that are based on the two main approaches to coordination: those based on electronic structures adapted from the economic structures of markets and hierarchies (Malone et al., 1987; Bakos, 1991; Choudhury, 1997); and those based on the interdependence view of data (Kumar et van Dissel, 1996; Liu and Kumar, 2003).

Researchers that have adapted transaction cost theory (Williamson, 1985) to data exchanges have defined electronic configurations of exchanges, such as electronic hierarchies and electronic markets. The typology of Choudhury (1997) is convenient to our research objectives because it is a starting point in addressing the electronic configurations of data exchanges between several sellers and several buyers. Choudhury (1997) specifies three types of IOS, electronic monopolies, electronic dyads and multilateral IOS. Because our objective is to emphasize the development of IOSs for a firm with its partners, we do not take it into account electronic monopoly which refers to the choice of a firm to implement a unique electronic link with one of its trading partners. Electronic dyads are bilateral IOSs where a firm establishes individual logical links with each of its trading partners. A multilateral IOS consists of building a single logical interorganizational link for a firm to communicate with all its trading partners (Table 1). The logical structure of interorganizational linkage as the antecedent of electronic dyads and multilateral IOSs is a good way to understand how the flows of data from sender to receiver can be designed. Indeed, in light of our research question, electronic dyads and multilateral IOSs are two types of IOSs that can occur for product information exchanges. However we consider they can only partially explain the diversity of electronic exchanges. Indeed, it does not explain sufficiently how the data flows are related to these linkages.

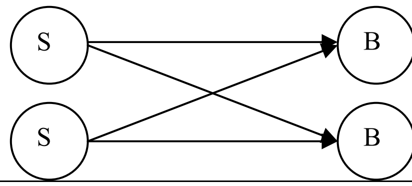
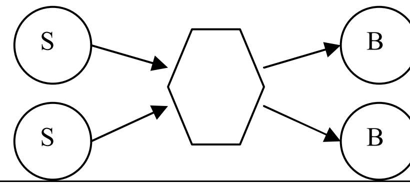
IOS types	Electronic dyads	Multilateral IOS
Logical linkage	For each firm, one electronic link per partner	For each firm, a unique electronic link to communicate with all its partners
Structure of data flows		

Table 1. Types of IOS from logical interorganizational linkage (Choudhury, 1997)

Another way to address the coordination of data exchanges is the interdependence view of coordination. In the coordination theory, Malone and Crowston (1994) defined coordination as the management of dependencies between activities. Coordination theory can be applied to IOSs when defining the data to be the resources exchanged between senders and receivers. Using the three main types of interdependencies proposed by Thompson (1967), Kumar and van Dissel (1996) identified three types of IOS: hub-and-spoke IOS (Liu and Kumar, 2003), characterized by pooled interdependency since data are common resources shared by several companies in a hub; value/supply-chain IOS characterized by sequential interdependency since data are the output of the sender and become the input to the receiver; and networked IOS where interdependency is reciprocal between companies. Because we concentrate on flows from sellers to buyers, reciprocal interdependency of data does not fit with our conception of exchanges. Pooled interdependency of data means, in this conception, that data from sellers are shared with several buyers. So sellers send data to the hub, and this hub dispatches the data to the buyers concerned. Electronic catalogues are presented as hub-and-spoke IOSs (Nakatani et al., 2006; Legner and Schemm, 2008) to coordinate electronic data exchanges through a pooled interdependency of data between companies. In the sequential interdependency of data, data are not shared with other companies than the two involved in the dyadic relationship, so we face a combination of parallel flows of data, each from one seller to one buyer. Traditional EDI is presented as a typical supply-chain IOS (Liu and Kumar, 2003) because data are only shared by the companies involved in a buyer/seller relationship. Looking at our research question, value chain IOSs and hub-and-spoke IOSs are two types of IOSs that can be used for product information exchanges. However, they can only partially explain the diversity of electronic exchanges. Indeed, it does not fully explain how the data flows are derived from these interdependencies.

Moreover, considering these developments, sequential interdependencies seem to be in line with the structure of data flows proposed in electronic dyads and pooled interdependencies with the structure of data flows proposed in multilateral IOSs. Therefore, this research asks whether this is a logical outcome or if other forms exist and are stable. Secondly, because of the importance of data privacy in B2C relationships (Culnan and Amstrong, 1999) and e-commerce (Dinev and Hart, 2006), this research also asks how the nature of data, from their privacy perspective, influences the choice of a particular form of electronic exchange.

1.2 Propositions

In order to build a typology of IOSs, we propose to first characterize systems firms may implement thanks to the combination of three factors: nature of data, message interdependency and logical linkages. However, contrary to past literature, these considerations do not aim at defining different forms of IOSs but different types of sending and receiving systems firms may build. The second step is about the IOSs that should occur from the interconnection between this set of sending and receiving systems.

Considering the links between nature of data and message interdependency, private data should be only exchanged within messages through sequential interdependency (Kumar and Van Dissel, 1996), whereas neutral data can be exchanged with messages either through sequential or pooled interdependency (Kumar and Van Dissel, 1996).

In addition, governance structure also influences the type of data flows. If electronic dyads (Choudhury, 1997) are used in an industry, all the firms build individual logical links with each of their partners, so messages can only be exchanged through sequential interdependency (Kumar and Van Dissel, 1996). If a multilateral IOS (Choudhury, 1997) is used by all the firms of an industry, each of them builds a single logical link to communicate with all its trading partners, so messages can be exchanged either through sequential or pooled interdependency (Kumar and Van Dissel, 1996).

Table 2 summarizes these considerations of links between nature of data, messages interdependency and structural linkages to propose 5 types of sending or receiving systems.

Sending or receiving system	Nature of data	Structural linkage	Message interdependency
System 1	Private	Dyadic linkages	sequential
System 2	Private	Multilateral linkage	sequential
System 3	Shared	Dyadic linkages	sequential
System 4	Shared	Multilateral linkage	sequential
System 5	Shared	Multilateral linkage	pooled

Table 2. Types of sending systems and receiving systems

From this typology of sending and receiving systems, we derive and investigate the types of possible systems interconnection. Evidently, sending and receiving systems of the same nature can be easily interconnected. The main issue is to describe empirically and interpret theoretically the diversity of interconnected systems when sending and receiving systems are of different nature. Theoretically we can observe 25 combinations interconnecting sending and receiving systems. Are there conditions that restrict the compatibility when the two types of systems are of a different nature? What is in fact currently being implemented?

2 METHODOLOGY

The methodology we employed was defined in order to find empirical evidence of sending and receiving systems that are designed differently, leading to interconnections the previous literature on IOSs has not yet presented. Systems interconnection is very important in the retail industry in order to synchronize data between manufacturers and retailers (Legner and Schemm, 2008). This is particularly the case in France where discount operations are very frequent and where a large products assortment is offered in every point-of-sales. Moreover, product information exchanges between manufacturers and retailers are relevant to test our propositions. Indeed product information exchanges include considerations about data privacy and structural linkages that question the nature of flows.

2.1 Product information management in the retail industry

Product Information is defined as a set of data that represents the product in a B2B exchange between the manufacturer and the retailer. GS1, the global organization of standardization in the large retail industry, has developed a standard for product information exchanges, based on XML messages (EAN.UCC). It involves data that identify the product and the company that manufactures it, technical characteristics of the product, logistical characteristics, and marketing characteristics. For each product of each manufacturer, these data are shared data, because they have the same value for all the retailers. But the standard also includes complementary data that manufacturers and retailers can decide to exchange, such as prices and delivery terms. These are private data since their value is dependent upon the contractual relationship between one manufacturer and one retailer for each product.

The existing literature about product information exchanges (Nakatani et al., 2006; Legner and Schemm, 2008) mainly presents GDSN (Global Data Synchronization Network) as a mechanism to update product information between manufacturers and retailers. GDSN is based on flows of GS1 standardized messages which synchronize external catalogues: the source data pool of the manufacturer and the recipient data pool of the retailer. With several retailers and manufacturers, GDSN is a typical multilateral IOS as described by Choudhury (1997). Moreover, to achieve internal integration of data, some companies have also implemented an internal electronic catalogue, also called Product Information Management (PIM). PIM structures product information but it also acts as an intermediary between existing internal databases and the external data pool of the company (figure 2).

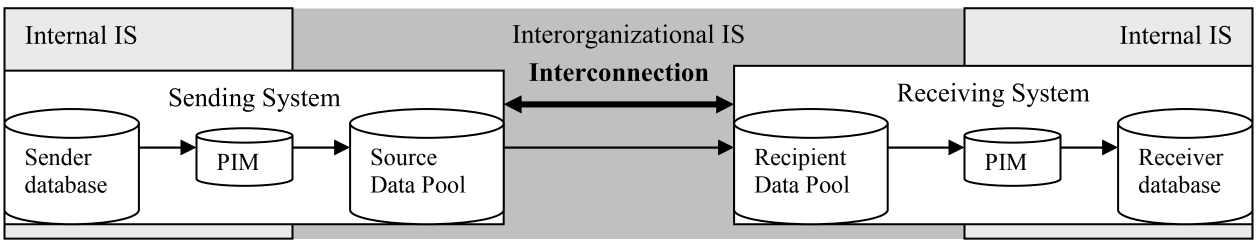


Figure 2. Data flows using Data Pools in Sending and Receiving Systems

Empirical evidence found in previous works (Nakatani et al., 2006; Legner and Schemm, 2008) shows that GDSN use is not widely adopted by companies in the retail and consumer good industries. Some of them estimate the standard does not cover their data needs (especially for private data described above), others that the use of an external catalogue incurs costs that can be avoided by the use of internal electronic catalogues. These considerations have led some companies to use their PIM to exchange messages without external catalogues (figure 3). Interconnections between PIMs constitutes a typical electronic dyad (Choudhury, 1997).

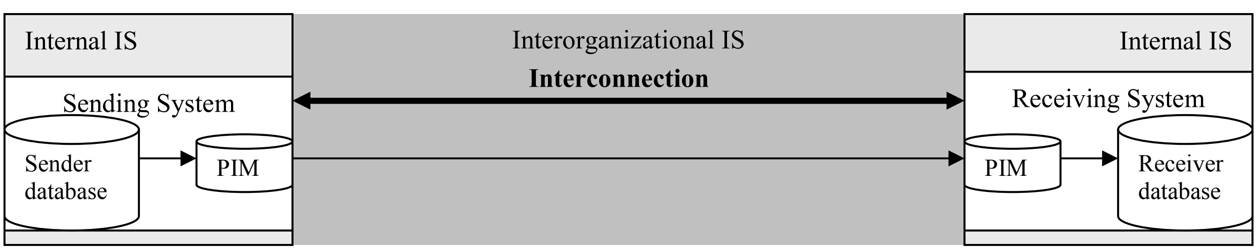


Figure 3. Data flows without the use of Data Pools in Sending and Receiving Systems

In addition to these two forms of IOS, one of our objective is to characterize other types of IOSs that occur from interconnection between diverse sending and receiving systems for product information exchanges.

2.2 Research design, Data Collection and Analysis

Qualitative methods seemed to be the most appropriate methods to address our research question, as they are recommended when the research aims to address a comprehensive framework of a contemporary phenomenon. The research design is a “multiple case, multiple embedded units” design (Yin, 2003), where the cases in this study are the individual manufacturers and retailers embedded in dyadic supplier-buyer relationships. Indeed, considering our exploratory research about types of IOSs that can co-exist in an industry, we decided to analyze numerous cases, even with little data collected per case, in order to have a sample that allows the discussion of several types of interconnection. The concentration in the French mass retail industry allowed us to include all the seven major French retailers in our analysis (Carrefour, Auchan, Casino, Système U, Leclerc, Intermarché, Provera). On the manufacturers’ side we analyzed companies implementing electronic catalogues in order to automate their sending of product information. At the end of data collection, 10 global manufacturers (e.g. Nestlé, Krat foods, l’Oréal and Danone) and 8 national ones (e.g. Fleury Michon and Tipiak) were included in our sample.

As Yin (2003) advises researchers to proceed, data from companies were collected through a variety of methods: semi-structured interviews, reviews of company and project documentation. Moreover, through semi-structured interviews and reviews of documentation, data were also collected from intermediaries proposing electronic solutions for product information exchange. This triangulation of data collection techniques provides multiple perspectives on the issues studied (Eisenhardt, 1989) and enhances the validity of the findings. The primary source of data is semi-structured interviews conducted between 2005 and 2007 in the 7 retailers and the 18 manufacturers in our sample. Because we focused on building technologies, we interviewed managers that were responsible for electronic catalogue implementation. 40 interviews were tape-recorded and transcribed for data analysis.

As recommended by Miles and Huberman (1994), a thematic qualitative analysis of the interviews was carried out by the use of QSR N’Vivo software, in which sentences or paragraphs were linked to the themes we had defined. This software has a function that allows the extraction of relationships between themes through tables, which was very useful in understanding the interconnections between receiving systems and sending systems implemented by companies.

3 CASE STUDIES RESULTS

3.1 The sending systems

8 manufacturers designed their sending system by the constitution of multiple dyadic linkages, and 11 with one multilateral linkage. 6 designed their system to exchange only shared data, whereas 14 include in addition private data. Finally, 15 designed the messages through a sequential interdependency and 5 use pooled interdependency. These first results constitute empirical evidence of the relevance of the three criteria we considered to describe the sending systems for product information exchanges in the consumer goods industry. Table 3 of results combines the structural linkage, the nature of data and message interdependency to underline the number of manufacturers using each of the 5 sending systems we built theoretically.

Type of sending system	Sending System 1	Sending System 2	Sending System 3	Sending System 4	Sending System 5
Number of firms	7	7	1	0	5

Table 3: Diversity of sending systems

We found 20 systems for 18 firms since some firms decided to use 2 sending systems in parallel. For instance, one manufacturer decided to use GDSN, with multilateral linkage to send only shared data into messages through pooled interdependency, and to use its PIM, with dyadic linkages, to exchange additional messages containing some private data through a sequential interdependency.

As shown in table 3, we did not find the five anticipated forms of sending systems. Indeed, the use of multilateral linkages to exchange shared data, does not lead to two types of sending systems because the flows are always designed through pooled interdependency. Therefore, sending system 4 is not empirically found. The four sending systems are finally dependent upon two variables (logical linkages and nature of data), because the message interdependency is given by the combination of these variables (Table 4).

	Dyadic linkages	Multilateral Linkages
Containing some private data	Sequential (Sending system 2)	Sequential (Sending system 3)
Containing only shared data	Sequential (Sending system 1)	Pooled (Sending system 5)

Table 4: Types of sending systems

3.2 The receiving systems

3 retailers designed their receiving system with multiple dyadic linkages, and 5 with one multilateral linkage. 3 want to exchange only shared data, and 5 include in addition private data. Finally, 6 designed their system to receive messages through sequential interdependency when 2 considers the reception through pooled interdependency. Similarly to sending systems, this first result constitutes empirical evidence of the relevance of considering structural linkages, nature of data and message interdependency to describe the receiving systems for product information exchanges in the retail industry. While most retailers have chosen a single type of receiving systems, one deliberately has chosen three in order to offer more possibilities for its supplier (system 1, 2 and 5). This is the reason explaining why table 5 presents 9 receiving systems instead of 7.

Type of receiving system	Receiving System 1	Receiving System 2	Receiving System 3	Receiving System 4	Receiving System 5
Number of firms	2	4	1	2	

Table 5: Diversity of receiving systems

However, we did not find the five anticipated forms of receiving systems. The use of multilateral linkages to exchange only shared data (two retailers) does not lead to two types of receiving systems. Whether the messages are designed from the manufacturers' IS through sequential or pooled interdependency, the retailer receives the messages without distinction. So receiving systems 4 and 5 are merged, since the design of the messages flows is not the concern of the retailer but only of the manufacturers. We will now keep the number 5 to define this receiving system in order to have a symmetry with sending systems. The four receiving systems are finally dependent upon two variables (logical linkages and nature of data), because the messages interdependencies are derived from the combination of these variables (Table 6).

	Dyadic linkages	Multilateral Linkages
Containing some private data	Sequential (Receiving system 2)	Sequential (Receiving system 3)
Containing only shared data	Sequential (Receiving system 1)	Sequential or Pooled (Receiving system 5)

Table 6: Types of receiving systems

3.3 Interconnections leading to IOSs

The present section is concerned with the question of interconnections between the four sending systems manufacturers have implemented and the four receiving systems retailers have implemented. We present in table 7 the interconnections between the systems, leading to different forms of IOS. In each case, we tinted cells in grey for which we find at least a dyad that justifies the existence of interconnection, when both the manufacturer and the retailer agree on the interoperability of their own systems.

	Sending system 1	Sending system 2	Sending system 3	Sending system 5
Receiving system 1				
Receiving system 2				
Receiving system 3				
Receiving system 5				

Table 7: The different interconnections

From our theoretical framework, we should have only found 16 types of interconnection among the 25 we proposed since one sending system and one receiving system were not empirically supported for product information exchanges. Among these 16 possible interconnections, we empirically found 13 different interconnections. For soft grey tinted cells, we face a logical interconnection of sending and receiving systems since they are symmetric systems. Therefore, our main result is that we found possibilities of interconnection between systems that are designed differently, represented through hard grey tinted cells. Some of these systems empirically show that interconnection is possible when sending and receiving systems are designed differently from nature of data perspective (system 1 and 3), from structural linkage perspective (system 1 and 2) and from messages interdependency (system 5 with other systems). These three perspectives constitute the bases of the discussion.

4 DISCUSSION AND CONCLUSION

From a structural linkage perspective, the configurations of interconnected sending and receiving systems show three main forms of IOSs. As proposed by Choudhury (1997), we found two forms of IOSs: electronic dyads, in which all the companies build dyadic linkages; and multilateral IOSs, in which all the firms build multilateral linkages. In addition, there are interconnections between some firms that build dyadic linkages and others that build multilateral linkages. Since dyadic IOSs and multilateral IOSs are derived from the economic forms of governance issued from transaction cost theory (Williamson, 1985), we define hybrid forms of IOSs as IOSs that interconnect partners with different designs of structural linkages, some implementing dyadic linkages and some multilateral linkages. Thus, these hybrid forms of IOSs can be placed on a continuum between two extremes, which are dyadic IOSs and multilateral IOSs. Figure 4 presents this continuum in the interconnection of eight firms: four senders (S1, S2, S3 and S4) and four receivers (R1, R2, R3 and R4). S1, S2, R1 and R2 use dyadic linkages and S3, S4, R3 and R4 use multilateral linkages. Thus, the interconnection between S1, S3 and R1, R3 is an example of an hybrid form of IOS.

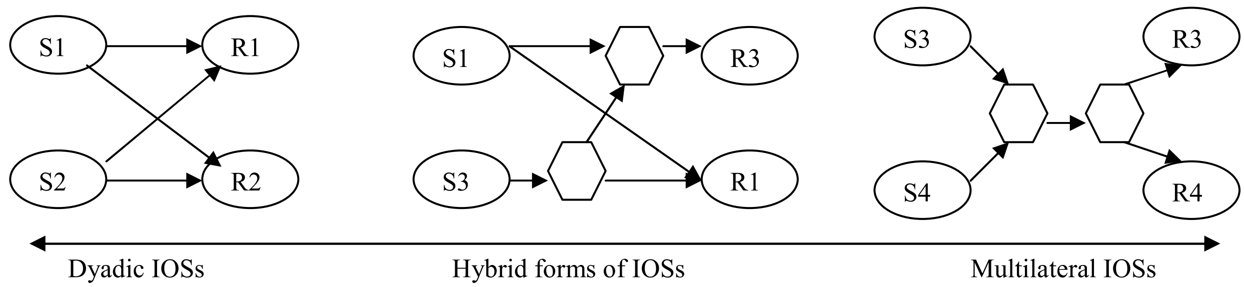


Figure 4. The continuum of IOSs types

Williamson (1985) considers hybrid organizational forms to be unstable economic forms that necessarily evolve towards hierarchies or markets. Thus, hybrid forms of IOSs may also be unstable forms evolving towards electronic dyads or multilateral IOSs. Hybrid forms are not necessarily stable forms. However, in hybrid forms each firm's choice will tend to last longer for at least three reasons and thus hybrid forms of IOSs may not be less stable than electronic dyads and multilateral IOSs. First, if one firm changes its connection (linkage) others do not have to do the same due to greater interconnection flexibility. Second, from the beginning of the IOS implementation each firm has greater choice and thus is less prone to change over time. Finally in the results, we found several firms that defend the choice to use multilateral linkages and several others that defend the choice to use dyadic linkages. In this case, a company faces a risk if it refuses to interconnect with its trading partners that propose different electronic linkages. Indeed, the critical mass (Markus, 1987) of partners that justifies the investments in the technology for electronic exchanges would not be attained. In an industry analysis, technical interoperability between systems that are different from a structural linkages perspective is a necessary condition to avoid this risk since hybrid forms of IOSs allow a firm to interconnect with all its partners. Discussing the strategic value of the structure linkages of IOSs needs also to consider which and how data can be exchanged.

From a nature of data perspective, both private and shared data can be exchanged in all the structure of the continuum we have built. Though being presented as a key element for IOSs adoption and diffusion (Markus et al., 2006; Zhu et al., 2006), we will not only discuss technical standards. At first, interconnection between different technical standards does not appear as a problem. Indeed, electronic catalogues, both internal (PIM) or external (Data Pool) can perform the translation between different technical standards in order to achieve external integration with the standard of the partner and internal integration with the internal standard. Because of the importance of internal integration in order to achieve benefits promised by electronic data exchanges (Mukhopadhyay and Kekre, 2002), the technology of electronic catalogues, both internal and external, is a real opportunity for companies. However, the data model is more problematic even if we have shown interconnection was possible between companies that want to exchange shared data, and those that want to exchange additional private data. In such a way, we can say that the interconnection between different data model leads to the implementation of the smaller data model, only composed of shared data. Outside the emergence of a global standard (Markus et al., 2006), the question is therefore about the emergence of a global standardized data model which may appear when all the firms of a specific industry find a consensus about the data that have to be exchanged and about their signification. Moreover, the macro-level perspective on data privacy can be extended to a micro-level perspective on each data included in messages. Indeed, a company can refuse to exchange a shared data, so that its partner can not exchange this data in the dyadic relationship. Outside the industry standard, we face proprietary standardized messages, since the data included in the message are dependent upon the negotiation of the data model between two companies. Thus, buyer/seller negotiations are the core condition of exchanges emergence for optional data - i.e. data that are included in the industry standard but not compulsory yet - and sometimes for additional data - i.e. data that the industry standard does not include -.

Considering the nature of data is not constrained by the structural linkages of IOSs, the main question is about the coordination mechanisms that manage interdependencies of data (Kumar and van Dissel, 1996; Liu and Kumar, 2003). Our results show that the main consideration of interdependencies is about the coordination of messages. Using the coordination theory (Malone and Crowston, 1994), we consider the messages to be the resource exchanged. Malone and his colleagues define three main coordination mechanisms: fit, flow and sharing (Malone et al., 1999). In this perspective, retailers conceive the reception of the message through a flow coordination whereas manufacturers conceive the emission of the message in a flow or a sharing coordination. Indeed, retailers receive a message in a flow coordination from the supplier that manufactures the product. If the manufacturer only includes shared data in a message and uses a multilateral linkage, it can send the message in a sharing coordination, since this message is then sent to several retailers. Otherwise, the manufacturer can send a message to a specific retailer, especially when the message contains private data, in a flow coordination perspective. Our main consideration is that the type of messages coordination does not need to be the same for receivers and senders because we found possibilities of interconnection between sharing coordination and flow coordination. In this case, from a coordination perspective, we face hybrid forms of IOSs. It should be interesting to extend these considerations for fit coordination, so when a company receives a message that contain data sent by several partners, these ones sending their data in a flow coordination.

Beyond the structural linkages perspective, we have discussed about the nature of data and the coordination mechanisms. The diverse hybrid forms of IOSs we have underlined have strategic value to interconnect firms that design different types of sending and receiving systems, in terms of structural linkages, messages coordination and nature of data. We have shown the diversity of IOSs considering the interconnection between sending and receiving IS for interorganizational product information management. Previous research presented simplistic types of IOSs, based either on structural linkages (Choudhury, 1997) or on interdependency of data (Kumar and van Dissel, 1996). In relationship with the private nature of data, we could conclude from this literature that:

- electronic dyads (Choudhury, 1997) are more convenient with sequential interdependency of data flows (Kumar and van Dissel, 1996), especially when companies exchange private data, which are dependent upon each dyadic relationship.
- multilateral IOS (Choudhury, 1997) are more convenient with pooled interdependency of data flows (Kumar and van Dissel, 1996), especially when companies exchange shared data, which are independent of dyadic relationships.

However the three dimensions were not systematically analyzed together and all their combinations had never been empirically investigated for one industry. Thanks to the new methodology we propose to analyze IOSs, and though our investigation is limited to a push mode, we found empirical evidence that shows the existence (real or potential) of IOSs other than the main types. We call them hybrid forms of IOSs, since they come from the interconnection between sending and receiving systems that present asymmetries in terms of nature of data, structural linkage or nature of flows. These hybrid forms are important not only because they allow a greater development of IOSs and foster new possibilities for automated updating of different sending and receiving systems, but by doing so they allow for a greater integration effect at the macro level. More importantly, for each company this integration effect can be achieved in a flexible way. We expect these results to be extended to other messages or sectors, when companies have to send both shared data and private data to their trading partners in a push mode.

One of the limitations of this research is related to the characteristics of the companies we have analyzed. We have distinguished the firms on their role as sender or receiver. From the retailers side of the relationships, this may be sufficient since they are all very powerful companies in France that retail the same products. But from the manufacturers side, it would be relevant to distinguish the manufacturers thanks to several characteristics, such as their bargaining power over retailers or the type of products they deliver. Further research should investigate if the type of sending system chosen is influenced by the type of manufacturer (global ones, national ones, SMEs) or the type of product (for instance fresh food) and which reasons motivate these choices.

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