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ADOPTION FACTORS OF ELECTRONIC DATA EXCHANGE AND TECHNOLOGY: CAN WE DISTINGUISH TWO PHASES?

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Abstract

In concordance with the emergence of technologies that allow more flexible interconnections, we propose to divide Interorganizational Information Systems (IOSs) adoption into two decision processes: electronic data exchange adoption and technological choices. These are sequentially and (in extreme cases) simultaneously related, albeit distinct, since an electronic data exchange decision rarely imposes a technological choice. In this context, the research aims at distinguishing factors influencing the decision for a company to adopt electronic data exchanges with its partners, and factors influencing the decision to adopt technologies supporting these electronic data exchanges. We investigate product information exchanges in the French consumer goods and retail industries through external catalogues, internal catalogues and Extranets. Analysis of 25 case studies allows us to conclude that it is relevant to distinguish these two decisions and the factors influencing each one.

Keywords: Adoption factors, interorganizational information systems, electronic data exchanges, technological choices.

Introduction

Interorganizational Information Systems (IOSs) are used to perform electronic data exchanges among businesses. The IOSs were defined in Barret and Konsynski's (1982) seminal article as "*automated information systems shared by two or more companies*", and are now recognized to be an important area of MIS research. Numerous factors that influence IOS adoption to support data exchanges among organizations have been identified. However, most studies discuss EDI (Electronic Data Interchange) adoption, or they use models of EDI adoption to explain other types of IOSs adoption. EDI is the computer-to-computer interchange of standardized messages between two parties¹ and allows better integration of data (Truman, 2000). In this paper, we analyze a broader set of electronic data exchanges, providing integration between two or more parties. Indeed, following Robey, Im and Wareham (2008), we consider that the theoretical implications of EDI research are limited for current theory building, since EDI refers to a specific type of IOS and narrows researchers' perspectives. Concerning IOS adoption, these considerations seem to be particularly valuable, since EDI adoption for a company and its trading partners involves the combined decision of adopting electronic data exchanges and the adoption of a given technology similar to the one used by both trading partners.

Given that new technologies provide more flexible opportunities for electronic interconnection (Christiaanse et al., 2004; de Corbiere and Rowe, 2010), it is relevant to analyze different phases in adoption. Thus, research on IOS adoption needs first to understand why companies decide to adopt electronic data exchanges with their partners and then why they adopt a given technology to exchange these data. Naturally, these two decisions are intertwined and develop during the same process although logically, the first occurs prior to the second. It is only in extreme cases that they are nearly simultaneous, when a sole technology can support electronic data exchanges of a given interorganizational process. We suggest that the main technological choices are not always made when the decision to adopt electronic data exchanges is taken, despite their interdependence in terms of the decision process. This research aims at: 1) understanding which factors influence the decision for a company to adopt electronic data exchanges with its partners and which factors influence the decision to adopt new technologies supporting these electronic data exchanges, and 2) examining if the two sets of factors are different or do not weight the same, which would be another indication, along with their timing, that the two decisions should not be confounded.

The rest of this paper is organized as follows. The first section presents the literature review on IOS adoption and classifies adoption factors into main categories. The second section explains the type of contextual data (Legner and Schemm, 2008) - product information exchanged between the consumer goods and retail industries - that we investigated, and the qualitative methodology we used. In the third part, the results extracted from the case studies are reported before ending with the discussion and conclusion.

1 Literature review on factors influencing IOS adoption

The literature on IOS adoption and implementation has a long tradition. However, it has not distinguished between the sequence of the two different decisions related to IOS adoption; this is because when most of these studies were conducted, this distinction was not as relevant as it is today. Therefore, at this stage, we use the literature review only to identify factors that are important for IOS adoption in general.

¹ <http://www.itl.nist.gov/fipspubs/fip161-2.htm>

1.1 Technological factors influencing adoption

Factors that have a positive or negative influence on technology adoption are different in nature. A company generally adopts a technology when it perceives benefits from its adoption and use. However, these anticipated benefits have to be balanced with perceived costs (Barrett and Konsynski, 1982) and perceived risks (Kumar et al., 1998). Therefore, technological factors refer to the perceived benefits, costs and risks of the technology (Iacovou et al., 1995; Subramani, 2004).

Past empirical research has explored reasons that explain IOSs development, use and success (Grover, 1993), as well as the benefits that can be issued from their use (Subramani, 2004). IOSs expand automation of data exchanges between companies (Suomi, 1992) and are referred to as systems that enhance productivity, flexibility and competitiveness for their users (Cash and Konsynski, 1985). Moreover, IOSs are all the more valuable when data integration, both external and internal, is achieved (Truman, 2000; Zhu et al., 2006). Data integration with business partners helps firms to enhance interorganizational efficiency (Bakos, 1991). However, at the industry level, automation and integration cannot be achieved without standardization (Markus et al., 2006), which is a prerequisite for operational benefits. In addition to operational benefits issued from automation, standardization and faster communication, IOSs can also provide strategic benefits related to potentially long-term benefits (Suomi, 1992). One can find similarities with the two distinct categories of benefits proposed by Iacovou, Benbasat and Dexter (1995):

- Direct benefits, such as transaction costs reduction, inventory levels reduction, and data quality improvement.
- Indirect benefits, as opportunities, such as operational efficiency improvement, better customer service, interorganizational relationships improvement or strategic competitive advantages.

Therefore, direct benefits refer to a technological and informational level of integration. Indirect benefits refer to strategic benefits that can emerge when business partners develop integration at the organizational level. Indeed, as argued by Bensaou (1997), companies can use interorganizational technology adoption to transform business relationships with some of their partners. Yi, Soh and Huang (2005) discuss IOSs effects on operational and strategic performance. Their results emphasize that both system and business integration lead to operational benefits, whereas only business integration leads to strategic benefits. These results are concordant with those of Markus, Steinfield, Wigand and Minton (2006) on interorganizational processes standardization. They underline that strategic performance is issued from business relationships integration and not from information systems integration.

To conclude, perceived benefits can be both operational and strategic, and are issued from different levels of integration realization between partners. However, perceived benefits have to be balanced with perceived costs and risks. Migration from proprietary systems to open standards based systems is supposed to help firms to adopt new IOSs, since they are less costly (Zhu et al., 2006). However, costs generated by project management have still a negative influence on adoption. Similarly, perceived risks have a negative influence on the intent to adopt (Kumar et al., 1998). Perceived risks mainly refer to return on investments (ROI). Especially, external integration consists of extending the solutions to a set of partners that can implement and use such a system (Iacovou et al., 1995). Therefore, external integration success depends upon the number of partners involved to maximize ROI, and the critical mass (Markus, 1987) of partners that emerges as a risk.

1.2 Organizational and interorganizational factors

Organizational factors represent a firm's capabilities to adopt and implement technology (Iacovou et al., 1995). Organizational factors are, for instance, company size, top management support, and financial and technological capabilities of the firm. An adoption decision is influenced by financial resources available to pay for system installation, implementation and use costs (Iacovou et al., 1995; Zhu et al., 2006). Decision is also influenced by technological considerations about "*the level of sophistication of IT usage and IT management in an organization*" (Iacovou et al., 1995).

Interorganizational factors represent environmental characteristics that influence technology adoption, such as the power over or trust of a partner (Hart et Saunders, 1997) or external pressure from competitors (Grover, 1993). Concerning technologies for developing or maintaining legitimacy in the institutional environment, “*organizations imitate early adopters to replicate their success or to avoid being perceived as laggards*” (Teo et al., 2003). Teo, Wei and Benbasat (2003) use institutional theory to identify the factors that enable the adoption of interorganizational systems. Coercive pressures occur in a dyadic relationship, when a dependent firm is pressed or feels pressed by its dominant partner to adopt IOS. Numerous studies have shown that pressures exercised by a powerful firm influence its partner’s decision to adopt IOS (Grover, 1993; Iacovou et al., 1995; Premkumar and Ramamurthy, 1995). A firm faces mimetic pressures when IOS diffusion is quite important among its competitors or when it perceives success of a competitor that has adopted IOS (Premkumar and Ramamurthy, 1995). Normative pressures arise when IOS diffusion is important among the firm’s customers or suppliers or when the firm participates in associations promoting the IOS. Firms promoting technology and standards influence IOS adoption (Grover, 1993).

From the literature review, we select four main categories of adoption factors: (1) perceived benefits, (2) perceived costs and risks, (3) organizational capabilities, and (4) interorganizational pressure and support.

2 Field of application and methodology

In this part, we present and justify the choice of studying product information exchanges between manufacturers and retailers of food and household merchandises, and the qualitative methodology we conducted.

2.1 Product information exchanges between consumer goods and retail industries

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). Over the last ten years, the retail and consumer goods industries have developed technologies to improve integration of product information through data synchronization (Nakatani et al., 2006). Data Synchronization is a concept representing the process allowing trading partners to have data with the same values in their own internal information systems (Legner and Schemm, 2008; de Corbiere and Rowe, 2010). So any change of product information in the internal information system of a manufacturer induces a real-time modification of this product information in all the internal information systems of the clients that retail this product. Consequently, this form of electronic data exchanges exceeds EDI since product information updates concern more than one sender and one receiver. To achieve data synchronization, Global Data Synchronization Network (GDSN) has been proposed. GDSN is based on a network of data pools, or external electronic catalogues, defined as repositories of standardized product information (Nakatani et al., 2006). With such a network, a company needs to build a sole connection to its data pool in order to communicate with all its trading partners in the global economy (Legner and Schemm, 2008). However, GDSN is not the only way to exchange contextual data about food and household merchandises in consumer between consumer goods and retail industries (Nakatani et al., 2006; de Corbiere and Rowe, 2010). Indeed, in the French retail industry, retailers can adopt from one to three different ways to receive product information electronically:

- through an external electronic catalogue, belonging to GDSN or not,
- through a “Direct link” from its internal system by the implementation of an internal electronic catalogue, or
- via an Extranet where suppliers can enter manually the data required.

Similarly, the manufacturer can adopt from one to three solutions to send product information:

- through a external electronic catalogue, belonging to GDSN or not,
- through a “Direct link” from its internal system by the implementation of an internal electronic catalogue, or
- via the Retailer Extranet in which it enters manually the data required.

Consequently, several types of IOSs are emerging to improve data synchronization between manufacturers and retailers; it is thus relevant to understand (1) the reasons that justify a company adopting electronic data exchanges and (2) the reasons that justify technological choices of this company to better synchronize its data with its partners. The following subsection explains the qualitative research we conducted to investigate adoption by manufacturers and retailers of electronic data exchanges and related technologies for their product information exchanges.

2.2 *A qualitative research*

Given the mainly inductive nature of this research, qualitative methods have been selected. They are more appropriate methods than quantitative ones to analyze and distinguish adoption factors of two decisions that are intertwined. The research design is a multiple case studies design (Yin, 2003), in which the cases are individual manufacturers and retailers. In a vertical market, the literature distinguishes firms that initiate an IOS adoption (often buyers) from their business partners (often suppliers) that are considered to be followers, since they adopt an IOS due to pressure from initiators (Riggins et Mukhopadhyay, 1994). Concerning product information exchanges, retailers act as initiators, since they can gain more advantages from IOS use than do their suppliers. Indeed, they have more products for which they would no longer need to re-enter the data in their own systems.

The first category of firms we analyzed is constituted by retailers: All the seven major French retailers (Carrefour, Auchan, Casino, Système U, Leclerc, Intermarché, and Provera) were included in our sample. Because of their number, we were limited to a sample of the manufacturers. To benefit from the use of an IOS initiated by their powerful partners, suppliers may implement their technological choices in order to better integrate their systems and businesses (Subramani, 2004). However, all manufacturers are not sufficiently sophisticated or powerful to design the IOS that they want. The more numerous and powerful brands a manufacturer has, the more it can design the IOS. On the contrary, SMEs generally act as followers (Riggins and Mukhopadhyay, 1994); therefore, we decided to distinguish between two extreme types of manufacturers: by their power and their size. From our data collection, 10 global manufacturers and 8 SMEs were included in our sample. Global manufacturers are defined as powerful firms that have a significant turnover in the global economy and brand names recognized by consumers. Global manufacturers included in the sample are Nestlé, Kraft foods, The Coca-Cola Company, l’Oréal, Danone, Colgate Palmolive, Reckitt Benckiser, Georgia Pacific, Cadbury Schweppes, Lactalis.

Data from companies were collected through a variety of methods: semi-structured interviews and reviews of company and project documentation (Yin, 2003). The primary source of data was semi-structured interviews conducted between 2005 and 2007 in the 25 firms included in our sample. Because we focused on building technologies, we interviewed managers that were responsible for B2B data exchanges or for the development of electronic product information exchanges. Considering the research objectives, we focused on the external validity of the findings, through intercase analysis, rather than internal validity with numerous data per case. Therefore, a second or a third interview was only conducted when several managers of the firm shared the responsibility for electronic development of product information exchanges. Forty interviews were tape-recorded and transcribed for data analysis.

Concerning data analysis, we focused on the 18 firms that had already adopted an IOS to realize a thematic qualitative analysis of the interviews (Miles and Huberman, 1994). In a first step, data were extracted to identify factors influencing the adoption of electronic data exchanges, to describe the technological choices of the company, and to identify the factors that motivated these choices. Given the inductive approach of the research, we distinguished: 1) the factors influencing the decision to adopt electronic data exchanges from interviewees’ considerations about the development of data integration; and 2) the factors influencing technologies adoption from interviewees’ considerations about advantages

and disadvantages of the chosen technologies compared to other ones. For each factor, we inferred from respondents' verbatim the weight of its influence on each decision by the creation of four codes (strong positive influence, weak positive influence, strong negative influence, weak negative influence). Then, through intercase analysis, we generalized case results in order to show: 1) the influence of the main adoption factors on the decision to adopt electronic data exchanges and 2) the influence of the main adoption factors on the technological choices.

3 Case studies results

In this section, we first present cases for which the two phases in IOS adoption are sufficiently distinct to affirm that it is relevant to identify factors influencing electronic data exchanges, on the one hand, and technological choices on the other. Then, for each case in each category of firms analyzed, a table summarizes the factors that motivate or inhibit the decision to adopt electronic data exchanges and the main reasons that explain these choices. After the tables are given, main insights are presented for each of the four main categories of adoption factors (perceived benefits; perceived costs and risks; organizational capabilities; interorganizational pressures and supports), considering both the decision to adopt electronic data exchanges and the technological choices.

3.1 *The distinction of several phases in the decision process: Sequential evidence*

In this part, we selected three cases for which the distinction between the adoption of electronic data exchanges and technological choices emerged from respondents' discourses. In our interview guide, we only asked them to describe the history of the project in their firm.

Case 1 (Retailer E). For this retailer, a first phase was driven by the CEO who noted, considering a first experience of electronic exchange of product information: *"There was a problem, there was something wrong. We needed to rethink our system from scratch."* He wanted to develop electronic data exchanges and asked to the CIO to design the IS without a technological target: *"We need a new tool. Give me a new solution."* In a second phase, a project manager, named by the CIO, benchmarked the different technological possibilities and chose among a set of possibilities the one that had a better fit with the firm's strategy: *"We decided to build an internal catalogue."*

Case 2 (Global Manufacturer B). For this global manufacturer, we distinguished three phases. In the first one, the French branch decided to develop electronic exchanges of product information through the implementation of an internal electronic catalogue: *"We wanted to start very quickly with Retailer A. So I asked to buy a tool that is hosted with us."* In this phase, it was difficult to distinguish between the two decisions. However, a second phase began when the parent firm decided to generalize electronic exchanges of product information with a given technology: *"Constraints to all project managers are threefold: ISYNC, standards and single product information."* Consequently, the French division decided to combine their previous investments and the general orientation of the parent firm who imposed an external catalogue. Thus, in a third phase, the French project manager decided to use several technologies: ISYNC with global standards, but also Retailers' Extranet when available to exchange complimentary data that were exchanged previously.

Case 3 (Retailer B). The project actually began with the realization of a business case on the value of electronic data exchanges: *"In 2003, a first business case was done to estimate benefits of electronic data exchanges."* The decision was made by the group to move towards electronic exchange of product information: *"Following the business case, the choice was made to launch the pilot in France in late 2004."* The project manager then compared the different technological solutions able to support electronic exchanges of product information. Considering the diversity of technological choices of their suppliers, the decision was made to develop multiple channels of reception: Extranet, internal catalogue, and

external catalogue. Thus, in this case, technologies were chosen to maximize suppliers' involvement once the decision to adopt electronic data exchanges had been made.

Such empirical evidence suggests that it is relevant to distinguish between factors that influence electronic data exchanges and those that influence technological adoption. The next sections describe the different adoption factors we found for each type of company.

3.2 Adoption factors for Retailers

Table 1 presents the results of the five retailers that had already adopted technologies to improve data synchronization concerning product information exchanges.

Retailer	Factors influencing electronic data exchanges adoption	Technological choices	Factors influencing technological choices
A	Data quality improvement (++) Productivity improvement (++) Buyer supplier efficiency improvement (+) Change management (-)	Internal catalogue	Suppliers involvement (++) Maturity of GDSN standard (--)
B	Data quality improvement (++) Productivity improvement (++) Buyer supplier efficiency improvement (+)	External catalogue, Internal catalogue, Extranet	Suppliers involvement (++) Interoperability (++)
C	Data quality improvement (++) Productivity improvement (+) Critical mass of manufacturers (--) Buyer supplier efficiency improvement (+)	External catalogue, Extranet	Stakeholder of an EMP proposing an external catalogue (++) SMEs involvement through GDSN (-) Outsourcing of technological complexity (++)
D	Data quality improvement (++) Productivity improvement (++) Buyer supplier efficiency improvement (+) Change management (-)	Internal catalogue	Perceived costs of external catalogues and Extranets (--) Supplier involvement (+) Proprietary standard development (++)
E	Data quality improvement (++) Productivity improvement (++) Project costs (--) Change management (-)	External catalogue	Stakeholder of an EMP proposing an external catalogue (++) Perceived costs of Extranets (--) Outsourcing of technological complexity (++) Industry standard as a guarantee of benefits for all (+)

Table 1. Adoption factors for retailers

3.2.1 Factors influencing the decision to adopt electronic data exchanges

Concerning perceived benefits, all retailers share two motivations that influence electronic data exchange adoption: data quality improvement and productivity improvement. Productivity improvement is issued from automation - whatever technological choices. From the retailer point of view, data receptions through electronic catalogues, both internal and external, or Extranets are all solutions that allow the realization of internal data integration, since product information from manufacturers are no longer re-entered by retailer employees. Thanks to these re-entering suppressions, human errors that previously occurred with traditional methods are suppressed. For most retailers, data quality improvement is the main factor of electronic data exchange adoption. Moreover, another benefit emerged that was perceived to be more strategic: the buyer/supplier relationship efficiency that could be improved, owing to product

information integration at the interorganizational level. Indeed, for some retailers, due to data quality improvement, there were fewer disputes and more cooperative opportunities.

Perceived risks and costs presented by retailers are about project and use costs of the future IOS and ROI. Retailers underline that project costs are important for these types of projects, especially to realize systems integration between their own information systems and the future IOS. For retailer C, the main risk associated with electronic data exchange adoption is the critical mass of manufacturers, since ROI can be positive if, and only if, enough partners exchange their data through the system. The only organizational consideration quoted by retailers does not concern their financial or technical capabilities. Indeed, it is more about change management that can be risky, and so they have to involve buyers in the project.

Finally, we found in retailers' arguments that perceived benefits issued from data integration, such as productivity enhancement and data quality improvement, are the factors that have the highest influence on the decision to adopt electronic data exchanges.

3.2.2 Factors influencing technological choices

Concerning technological choices, perceived benefits of the technology are less relevant than they are in the decision to adopt electronic exchanges. Indeed, choices are more driven by risk considerations, organizational capabilities and interorganizational context.

Retailer A has chosen to adopt an internal catalogue, since it finds the GDSN standard immature, and considers it risky to spend money for external catalogue implementation in this context. Retailer D prefers to adopt an internal catalogue since it offers greater flexibility to exchange complementary data outside the global standard. An external catalogue and the GDSN risk of not supporting the exchange of these data and retailer D estimates that costs induced by the implementation of such a catalogue will not have a sufficient ROI. Moreover, in their point of view, supplier involvement, which is a necessary condition for ROI, is easier with internal catalogue.

Retailer B, C and E chose external catalogues to reduce technological complexity issued from standard evolution and interoperability. However, retailers C and E constrained themselves with organizational capabilities. Indeed, since they are stakeholders of an electronic marketplace that has developed an electronic catalogue, they have to connect to this catalogue in order to maintain their marketplace ROI. Retailer B has a singular strategy since it proposes the three types of data reception. It considers that, whatever costs derived from all these solutions, ROI will mainly be guaranteed by the maximization of supplier involvement. With all the three types of data reception, interoperability problems (technical and/or organizational) with suppliers' choices are suppressed. Retailer B and C implemented an Extranet for SMEs involvement, whereas retailer A and D found Extranet too expensive.

3.3 Adoption factors for global manufacturers

Table 2 presents main results issued from the eight global manufacturers' case studies that had already adopted technologies to improve data synchronization concerning product information exchanges.

Global Manuf.	Factors influencing electronic data exchanges adoption	Technological choices	Factors influencing technological choices
A	Data quality improvement (++) Productivity improvement (++) Buyer supplier efficiency improvement (++) Change management (-) Project costs (-) Pressures from retailers (+)	External catalogue	Stakeholder of an EMP proposing an external catalogue (++) Product information standardization (++) Manufacturers consortium to resist pressures (++) Outsourcing of technological complexity (++)
B	Data quality improvement (++) Productivity improvement (++)	External catalogue,	Stakeholder of an EMP proposing an external catalogue (++)

	Buyer supplier efficiency improvement (++) ROI (--)	Extranet	Product information standardization (+) Outsourcing of technological complexity (++)
C	Data quality improvement (++) Productivity improvement (+) Pressures from retailers and competitors (+)	Internal catalogue	Maturity of GDSN standard (--) Keep control on data (++)
D	Data quality improvement (++) Productivity improvement (+)	Internal catalogue	External catalogue costs (--) Maturity of GDSN standard (--) Keep control on data (++)
E	Data quality improvement (++) Productivity improvement (+) Pressures from retailers (+) Project costs (--)	External catalogue	Stakeholder of an EMP proposing an external catalogue (++) Product information standardization (+) Outsourcing of technological complexity (++) Connection with internal systems (--)
F	Data quality improvement (++) Productivity improvement (+) Buyer supplier efficiency improvement (+) Pressures from retailers (++) Project costs (--)	External catalogue	Manufacturers consortium to resist pressures (++) Product information standardization (+)
G	Data quality improvement (++) Productivity improvement (++) Buyer supplier efficiency improvement (+) ROI (--) Change management (-) Pressures from retailers (+)	External catalogue	Stakeholder of an EMP proposing an external catalogue (++) Product information standardization (+) Outsourcing of technological complexity (++)
H	Data quality improvement (++) Pressures from retailers (++)	Internal catalogue	Internal data centralization (++) Keep control on data (+)

Table 2. Adoption factors for global manufacturers

3.3.1 Factors influencing the decision to adopt electronic data exchange

When we compare the results of global manufacturers with those of retailers, we find several points in common. Once again, perceived benefits issued from data integration are important factors influencing the decision to adopt electronic exchange of product information: data quality improvement and productivity enhancement, and strategic benefits associated with better efficiency of buyer/supplier relationships.

Similar perceived costs and risks are also considered in the decision process: project costs and ROI, depending on the critical mass of partners. Considerations of change management with sales managers are also taken into account. However, contrary to retailers, external pressures constitute a powerful determinant of electronic exchange adoption. One manufacturer perceives pressures from its competitors, but main pressures come from retailers. These pressures are sometimes presented as direct demands from retailers, but in most cases, indirect pressures from retailers, as anticipated pressures that will occur, have pushed manufacturers to adopt electronic data exchanges.

To summarize, as a participant of Manu A claims, “*We face pressures from retailers, but if there were no benefits for the company, we are powerful enough to resist.*” Finally, similar to retailers, perceived benefits issued from data integration are the factors that have the most influence on the decision to adopt electronic data exchanges, and pressure from retailers accelerates decision making.

3.3.2 Factors influencing technological choices

Concerning technological choices, perceived benefits of the chosen technology are generally amplified with perceived risks and costs of non-chosen technologies. For instance, external catalogues are chosen by manufacturers that consider internal catalogues do not allow outsourcing of technological complexity issued from standard evolution and interoperability. For some manufacturers, adopting an external catalogue is also a solution for creating a consortium of manufacturers that will be powerful enough to refuse the development of one standard per retailer. On the contrary, internal catalogues are chosen by manufacturers who consider external catalogues to be risky. Similar to retailers, we find organizational considerations that influence adoption of given technologies, such as being a stakeholder of an electronic marketplace that has developed an electronic catalogue, or not being ready for interconnecting internal IS with external catalogue. However, new factors emerged. For instance, internal catalogue adoption is also driven by data control considerations or by developing technological capabilities that can be used both for external and internal data transactions.

3.4 Adoption factors for SMEs

Table 3 presents main results issued from the five SMEs case studies that had already adopted technologies to improve data synchronization concerning product information exchanges.

SME	Factors influencing electronic data exchanges adoption	Technological choices	Factors influencing technological choices
I	Pressures from retailers (++) Buyer/supplier efficiency improvement (+)	External catalogue	Only one data re-entering for all the retailers in the external catalogue (++)
J	Pressures from retailers (++) Data quality improvement (+)	External catalogue	Only one data re-entering for all the retailers in the external catalogue (++)
K	Pressures from retailers (++)	Extranet	Costs minimization (++)
L	Pressures from retailers (++)	Extranet	Costs minimization (++)
M	Pressures from retailers (++)	Extranet	Costs minimization (++)

Table 3. Adoption factors for SMEs

Concerning SMEs, results are significantly different from those of global manufacturers. Most do not find perceived benefits in electronic data exchange adoption, and external pressure very much constrains adoption of electronic data exchanges. Only two of the five SMEs perceive benefits (data quality improvement and better relationships efficiency) in electronic exchange adoption. Logically, these SMEs decided to adopt an external catalogue in order to realize external data integration, without internal data integration. Other SMEs adopted Extranet because it was a less expensive solution.

4 Discussion and conclusion

Empirical evidence indicates that the decision to adopt electronic data exchanges and technological choices can be distinguished. In addition to the three cases we have underlined, results show that some perceived benefits are found, whatever the technological choices for all powerful firms. We can thus conclude that the decision to adopt the principle of electronic data exchanges and the decision to adopt technological support are not the same. Moreover, it appears that the two decisions are more intertwined when the firm faces organizational constraints that reduce the set of technologies it could adopt: financial capabilities for SMEs that impose the less expensive technology, and being a stakeholder of an electronic marketplace that imposes the use of the provided external catalogue for powerful companies. This brings us to the first proposition.

P1: The less that organizational constraints influence technological choices, the less the decision to adopt electronic data exchanges and the decision to adopt technology(ies) are intertwined.

Concerning powerful firms, whether they are initiators or not (Riggins and Mukhopadhyay, 1994), the results show that the decision to adopt electronic data exchanges is mainly driven by the perceived benefits of electronic data exchanges, and especially by the operational, direct benefits (Suomi, 1992; Iacovou et al., 1995). These benefits are issued from data integration (Zhu et al., 2006) and lead to productivity improvement (Cash and Konsynski, 1985) and data quality improvement (Iacovou et al., 1995). Moreover, they are all the more important when both internal and external integration (Truman, 2000) are realized, and data integration can lead to strategic benefits such as buyer/supplier relationship efficiency improvement (Iacovou et al., 1995). Moreover, organizational and interorganizational considerations do not have a strong influence on the decision to adopt electronic data exchanges. Even for manufacturers that act as followers, the results show that interorganizational pressures from initiators accelerate decision making, but that perceived benefits are the key factors for electronic data exchange adoption. We can thus conclude that powerful firms adopt electronic data exchanges when perceived benefits are greater than are perceived risks and costs. Concerning perceived costs and risks, main considerations are about project costs and ROI that are dependent upon the critical mass of partners with which integration can be realized (Iacovou et al., 1995).

P2: For powerful firms, perceived benefits issued from data integration are the key factors that influence the decision to adopt electronic data exchanges.

Concerning their technological choices, it appears that powerful partners adopt a technology with those that promise to achieve the perceived benefits issued from data integration, and with those that match their organizational constraints. Indeed, as argued in the literature, perceived benefits have to be balanced with perceived costs and risks. Technological choices are influenced by the relative advantage of a technology compared to others, each of them having their own perceived benefits, costs and risks. In product information exchanges, relative advantages of Extranet, internal catalogue and external catalogue are compared in terms of critical mass of partners and value (research of complexity outsourcing, data standardization, data control keeping, internal data centralization). Moreover, organizational factors (Iacovou et al., 1995), such as financial capabilities to support technology implementation costs or technological capabilities available (re-use of an existing technology), generally reduce the set of technologies that allows the development of data integration. Indeed, organizational capabilities generally eliminate some technologies among the set of possibilities. Finally, external pressures are not so important for technological choices, owing to interconnection possibilities between different technologies (de Corbiere and Rowe, 2010). Consequently, external pressures influence the decision to adopt electronic data exchanges, rather than the technological choices.

P3: For powerful firms, the relative advantage of technologies under organizational constraints drives technological choice.

Concerning SMEs, in accordance with extant literature, the coercive pressure from retailers has a strong positive influence on electronic data exchange adoption. This is not an innovative result, since the literature has long emphasized that pressures from initiators with market power constitute a powerful determinant of IOS adoption for their business partners (Grover, 1993; Premkumar and Ramamurthy, 1995; Subramani, 2004). As argued by Iacovou, Benbasat and Dexter (1995), coercive pressures are sometimes the main IOS adoption factor, especially for SMEs.

P4: The smaller the firms, the more the external pressure from business partners becomes the main factor that influences electronic data exchange adoption.

Consequently, the two decisions are more intertwined than they are for powerful firms. Indeed, under network externalities issued from their business partners' technological choices, organizational capabilities, and especially financial ones (Iacovou et al., 1995), drive adopting the technology. Indeed, if organizational capabilities are limited, SMEs select the less expensive technology, Extranet, for product information exchanges. If their financial capabilities are sufficient enough, they can adopt a more sophisticated and expensive technology. For product information exchanges, they adopt external catalogues, since these are the ones that lead to external data integration achievement because of their

interoperability with all the technologies of retailers, even if they do not perform internal data integration from their internal systems.

P5: Under their business partners' pressure to develop their electronic data exchanges, technological choices of SMEs are mainly influenced by financial capabilities considerations.

Whereas past literature considered IOS adoption as a whole, we can distinguish two phases in IOS adoption: electronic data exchange adoption and technology adoption. The distinction is all the more important at the time of open standards based systems (Zhu et al., 2006) and intermediaries (O'Reilly and Finnegan, 2010), which provide more flexible opportunities for technology interconnections (de Corbiere and Rowe, 2010). We have provided empirical evidence that factors influencing the two phases of adoption are different not only in magnitude, but also in nature. Specifically, external pressures have greater influence on electronic data exchange adoption, while organizational capabilities are more focused on the choice of a technology among a set of possibilities. Following our results, a powerful firm can exercise power in a coercive or persuasive way (Hart and Saunders, 1997) to influence adoption of electronic data exchanges by its partners, without influencing their technological choices. Therefore, these partners can adopt the technology that better corresponds to their organizational capabilities and constraints, as well as their perceived benefits. Future research should investigate if increasing the interoperability between different technologies that are designed to support the same process may lead to wider and faster adoption and use of IOSs. Moreover, complementary investigations should be conducted on other countries, processes or retail sectors to test, confirm or refine the propositions derived from our field study.

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