Summer 6-15-2016

UNDERSTANDING THE UNDESIRABLE EFFECTS OF USING INTERORGANIZATIONAL SYSTEMS AND INTEGRATED INFORMATION SYSTEMS: CASE STUDIES AMONG SUPPLY CHAIN PARTNERS

Gwenaëlle Lairet
Ecole des Mines de Nantes,

Frantz Rowe
Université de Nantes

Bénédicte Geffroy
Ecole des Mines de Nantes

UNDERSTANDING THE UNDESIRABLE EFFECTS OF USING INTERORGANIZATIONAL SYSTEMS AND INTEGRATED INFORMATION SYSTEMS: CASE STUDIES AMONG SUPPLY CHAIN PARTNERS

Research

Gwenaëlle LAIRET, Ecole des Mines de Nantes, LEMNA

Frantz ROWE, Université de Nantes, LEMNA, SKEMA Business School

Bénédicte GEFFROY, Ecole des Mines de Nantes, LEMNA

Abstract

Researchers and practitioners present entreprise integration to a Supply Chain as a lever for organizational performance. Yet if integration is generating performance, this cannot be done without the acceptance of new constraints due to integrated information systems implementation. We discuss the evaluation of the information systems that support the integration in order to uncover some negative consequences associated with their use. We mobilize the concept of undesirable effects and thus pose our research question: How can we identify and assess undesirable effects for users of integrated information systems or interorganizational systems? We analyze the perceptions of users on the effects of regular use of technology for their logistics activity. We adopt a qualitative methodology and select two case studies of just-in-time supply chain in the food and automotive industry. Data collection is carried out through interviews and analyzed by thematic coding. The results lead to identify twelve undesirable effects, four of which are specific to the use of interorganizational information systems. These results may extend the typology of misfits of Strong and Volkoff (2010) by entering the notion of undesirable effects to assess the negative consequences for users of the use of integrated information system.

Keywords: Undesirable effect, supply chain, Interorganizational Information System, user evaluation

1 Introduction

The search for optimization in the management of interorganizational flows can be supported by the implementation and use of architectures interconnecting or integrating information systems between different organizations (Bidan et al., 2012; De Corbière and Rowe, 2013). When companies engage in an integration process with their suppliers or customers, they tend to invest heavily in information technology (Rai et al., 2006). However, technological integration in an interorganizational context can apply to different areas and respond to various organizational objectives that require to be described (Giachetti, 2004). Moreover, some studies demonstrate the positive results of the integration of IT on the operational performance of the companies (Wang et al., 2006, Kärkkäinen et al., 2007, Mithas et al., 2012). In this positive relationship, it is emphasized that these gains are realized only under certain conditions of implementation and acceptance of new constraints due to this implementation (Maiga et al., 2015). Negative consequences of IS integration are a blind spot in the literature on interorganizational information systems and, if their existence has already been established regarding the use of a single technology (Robey and Boudreau, 1999, Strong and Volkoff, 2010), they are neither identified nor analysed by looking at various applications at the user level in a supply chain context. Without a global vision of all effects resulting therefrom and affecting individual performance systems integration trends continue to develop.

The objective of this paper is to identify and assess the negative consequences from the use of integrated or interorganizational information systems for the individuals. To describe these consequences, we propose the concept of undesirable effects and the following research question: How can we identify and assess undesirable effects for users of integrated information system or interorganizational information system in a supply chain context? To answer this question, we adopt a qualitative methodology through supply chain case studies. The results of our research provide empirical evidence to identify and assess the consequences of the presence of the undesirable effects for individuals in the context of supply chains. Undesirable effects contribute to the literature on the evaluation of interorganizational information system and extend the typology of misfits (Strong and Volkoff, 2010).

2 Conceptual framework

2.1 IS Integration and IOS in supply chain contexts

Integration is still nowadays a priority in managing information systems, and the literature in information systems is constantly evaluating the effects of technology integration on business performance. These evaluations tend to demonstrate the positive impact of integration (Davenport, 1998; Markus and Tanis, 1999; Markus, 2001) especially with ERPs' (Entreprise Resource Planning) adoption. Few researches question the need for integration (Singletary, 2004) and even less, the possible negative consequences related to it (Strong and Volkoff, 2010). In a supply chain context, technology integration promotes the integration of process (regardless of the effect on performance) to move towards an integrated enterprise (Narasimhan and Kim, 2002; Gunasekaran and Ngai, 2004; Rai et al., 2006). However the logistics business has also some specific high requirement on the continuity of information, data quality (De Corbière et al., 2016), and access to information throughout the interorganizational logistics process. The logistics business requirements lead to interactions between IS leading to integration projects and involve in some cases the use of interorganizational applications (IOS) to support processes across several organizations (Wang et al., 2006; Prajogo and Olhager, 2012) as well as the use of applications, which are integrated only at the intra-organizational level. IOS is a research subject on its own in many articles (Grover and Saeed, 2007, Wang and al., 2013). Prior studies on this topic treat IOS at an aggregate level, or analyse it inconsistently within a single organization (Saeed et al, 2011). The selected organization is in addition most of the time the central firm of the supply chain. Consequently this bias offers a truncated vision of the IOS focusing on one organization that is using it. This same literature on IOS generally offers a rather strategic and predictive vision of

favourable conditions for a good development and operation of the company in the context of supply chain. The IOS operational impacts are yet evaluated in the literature, however these evaluations are intended to assess only the positive effects of IOS on the effectiveness of operations, processes and administrative tasks, reducing costs and increasing sales prices (Clemons and al., 1993, Robey and al., 2008).

2.2 Types of functional integration for the logistics activity

The supply chain integration is generally supported by technological integration (Gunasekaran and Ngai, 2004, De Corbière et al., 2012). The IS adoption in this interorganizational context aims to exchange, share or make available the required information for the integrated business (Seddon and al., 2010). Regarding the organizations objectives for their supply chain relationships, types of integration can be different. Three main types of functional integration can then be described related to the processing and exchange of information (Cf. Table 1). 1/ The integration named "transactional" aims to execute the transactions to improve operations processing (Auramo and al., 2005; Kärkkäinen and al., 2007). The primary motivation of this integration is to automate and speed up cross-functional information flows in order to streamline the logistics process and obtain quality data (reduce the potential for human data entry errors). In this case, applications are integrated with each other without data unification. This type of integration may be supported by technologies as EDI. 2/ The integration named "informational" aims to unify, standardise and share operational or strategic information (Sanders and Premus, 2002; Kärkkäinen and al., 2007). This integration for logistics aims to provide available and visible information at any time. Information technology allows optimizing exchanges by enabling a single point of contact for data. The primary motivation of this level of expectation for the company is to reduce transaction costs. We find in this context the adoption of an ERP or a common database (operational database or data warehouse). 3/ The integration named "collaborative" gives support for coordination and collaboration among supply chain partners (Kärkkäinen and al., 2007). The technologies help to conduct collaborative and control processes supporting collaborative decision, and allow performance monitoring and coordination of unstructured tasks. This kind of integration is supported by EDI (Electronic Data Interchange) adoption to facilitate the implementation of collaborative operations (ordering, invoicing, delivery check and editing checklist) between partners in business purchases, procurement, production and logistics but also collaborative applications for strategic information as SCM (Supply Chain Management application) or CRM (Customer Relationship Management application).

FUNCTIONAL INTEGRATION	CONTRIBUTION TO THE LOGISTICS PROCESS	APPLICATIONS PERIMETER	
Transactional	Effective and smooth execution of internal transactions	*intra-organisational IT*	*interorganisational IT*
Informational	Centralized, visible and available information		
Collaborative	Coordination and collaboration between the Supply Chain partners		

Table 1: Types of functional integration in supply chain context

2.3 Information system functionality evaluation

IS literature uses the notion of fit to assess appropriateness of the technology to the needs of the organization, and thereby the achievement of the performance objectives targeted by the use of the infor-

mation system. The "*functionality fit*" evaluates the information systems through similar dimensions to those of this research. In fact, the functionality fit is defined as "*the extent to which the functional capabilities embedded and configured within an Enterprise System package match the functionality that the organization needs to operate effectively and efficiently"* (Seddon, et al., 2010). The authors mobilizing the fit, hypothesize that the better the fit, the higher performance that results (Goodhue and Thompson, 1995; Goodhue, 1998; Gebauer et al., 2010; Strong and Volkoff, 2010). The fit tends to highlight the positive feedback from users of the technology and its positive impact on the performance of the organization. The fit is thus revealed as a dichotomous outcome (positive impact or no impact) of the use of technology to accomplish work tasks (Goodhue et Thompson, 1995). This dichotomous perspective seems simplistic and biased for a realistic assessment of the IS contribution to the performance. Thus, the target performance through the implementation of the information system may be achieved (the fit is assessed) and assimilated by the organization, while at the same time the use of the system generates negative and unexpected effects sometimes named misfit (Sia and Soh, 2007; Soh and al., 2003; and Wang and al., 2006; Strong and Volkoff, 2010).

2.4 Beyond misfit: the concept of undesirable effect

The construct of misfit (Strong and Volkoff, 2010) aims to assess within the use, consequences of the implementation of the information system, perceived as negative by users. These mismatches may represent minor inconveniences to critical dysfunction for users (Strong and Volkoff, 2010). In this sense, the misfit seems very close to our research object. Nevertheless, the misfit is mobilised at a level of analysis, a time of analysis and for a technology, which are different in our research.

In fact, Strong and Volkoff (2010) analyse the negative effects of the IS (the misfits) at the corporate level and propose an aggregate level for the effects. This article aims to assess the mitigated or negative perceptions from the users regarding the adequacy of the information system to the performance of the their tasks. This broader approach may reveal new effects in the feedback of the users and demonstrates that IS effects may not only be beneficial but potentially harmful to the user's activity. This article seeks to observe the applications at the task level in order to achieve a detailed presentation of the diversity and nature of effects for individuals. This level of observation mainly leads to bring out the effects of the information system on working operations. Indeed, users are primarily sensitive to what may hinder the effective continuity of their own daily tasks and rarely mention the effects of the information system impacting the entire organization. The analysis focuses on the individual and operational level effects even if we are aware that the different levels of analysis are eventually interdependent.

Moreover, misfit evaluates the ERP in use, but in a short time that follows its implementation (Soh and al., 2003; Strong and Volkoff, 2010). Strong and Volkoff (2010) study the misfits by comparing the situation preceding the implementation of the ERP, and the one that follows. In this regard, we are expanding the definition of degraded situation by including all the reductions in efficiency compared to a previous situation. The previous situation is not only the one preceding the implementation of the ERP but includes different kinds of previous situations as situation with no information system; with different system information; with an identical information system.

Eventually, previous works based on the misfit study a single technology (ERP) and within the very same organization (Soh and al., 2003; Strong and Volkoff, 2010), whereas we look at different kind of applications, used simultaneously, by the same individual. This level of observation can in fact restrict the types of effects observed. Furthermore, this article focuses on the routine use when the information system is in place for more than a year and when the project phase is fully complete. This phase of the life cycle of the information system is the phase of routinization (Cooper and Zmud, 1990). The use of the information system is then promoted as a normal activity fully integrated within the company's stakeholders work routine. The phase of everyday use is still little studied and yet it turns out that "*the*

effective use of information systems is a critical issue that is related to the use of post-adoption phase of the Information System" (Saeed and Abdinnour, 2013, p. 220).

Thus, the misfit is limited to describe fully and finely the negative consequences of the use of integrated IS for individuals in an interorganizational context. To describe the consequences of the information system on the organization, there are two similar terms, but different in their use. The term "impact" refers more to the idea of “influence” and is rather used in quantitative models. In addition, the word impact is often related to a deterministic approach of the information system. We prefer the term "effect" which is more neutral and is synonymous of "consequence", including deliberate or emergent effects, anticipated or unexpected effects (Orlikowski, 1996; Robey and Boudreau, 1999). Whereas Maurer, Berente and Goodhue (2012) speak of fit as necessarily " desirable" for the organization, we develop the "undesirable" effects. This term is already used to describe negative consequences for the workers of the just-in-time adoption (Inman and Brandon, 1992). In the same way, our effects are undesirable for users when they consider their presence harmful or binding to the achievement of their business. These effects occur when the user’s needs or uses have no correspondence in functionality and operation of the application and lead to negative consequences in his/her work. However these effects may occur without challenging the initial objective of the implementation of the information system, which often responds to strategic issue. The undesirable effects can arise from the use of a single application but can also arise from the interactions between information systems within the organization or with other organizations within the interorganizational process (Im and Rai, 2013) and according to different types of integration.

We point out the limits of the fit and misfit concepts regarding our research subject and develop the concept of undesirable effect to assess integrated information system.

3 Research Method

3.1 Case studies: Just-in-time supply chains

The specific feature of our research is primarily based on the study of interrelated organizations in joint business processes. The supply chain is an original methodological position because it allows a comprehensive view of interorganizational information system from different organizations (Klein and Rai, 2009). We then focused on the users’ perceptions of the information system in an interorganizational context regarding the performance of their tasks. Users were the ones contributing to the logistics activity because they tend to be a staff closely related to interorganizational relationships management, and to all the applications dedicated to them. The sample covered two different industries which common characteristic is their management of the supply chain logistics flow in just in time. Indeed, just in time management exacerbates the speed of information and good flow and involves a high degree of interdependence between tasks. The choice of this kind of demanding management allows accentuating the visibility of undesirable effects.

We selected nine companies part of two different Supply Chain. The first supply chain falls within the food-processing industry. To maintain consistency on businesses in our case study, we chose to focus on the activity of fresh and frozen products. This supply chain is composed of three industrial manufacturing and processing companies, a nationwide distributor, and a logistics provider, which is working with the other four. Each industrial enterprise is a multi-site group of entities acquired over time and is in this sense, representative of the industry. We interviewed 17 participants within the logistics process for a total time of 18 hours (Cf. Table 2). We visited the sites of each company except for one.

The second supply chain falls within the automotive industry. We studied within this supply chain, a French car manufacturer; a provider of door panels and hood bumper; a vehicle-processing subcontractor and a logistics provider specialized in the calculation of supply transport plans. We interviewed 10 participants in the logistics process for a total time of 7h and visited each site (Cf. Table 2). The applications used by the interviewees are listed in table 3. Much information was also collected during

the plants visits. We triangulated interviews findings (Wynn and Williams, 2012) with company documents when they were available, with observations and additional information collected by email from contacts when needed.

INDUSTRY	COMPANY	FUNCTION	LOGISTICS ACTIVITY	INTERVIEW TIME
FOOD	MANUFACTURER 1	Shipping manager	Distribution	1:00
		Inventory manager	Inventory	1:30
		Aftersales manager	Order management	1:30
		Sales Forecasting	Order management	01:30
	MANUFACTURER 2	Customer service and logistics manager	Order management	1:10
		Logistics grocery	Order management	1:10
		Sales IS manager	IS	0:50
	MANUFACTURER 3	Flow manager	Distribution	1:30
		Procurement staff	Procurement	0:45
		Supply Chain Director	Order management	1:20
	DISTRIBUTOR	Inbound transport manager	Procurement	1:10
		Logistics methods and studies	IS	0:40
		Frozen warehouse manager	Inventory	1:00
		Procurement manager	Procurement	0:50
		Logistics manager for fresh products	Distribution	0:45
	LOGISTICS SERVICE PROVIDER 1	Operations manager	Distribution	0:30
		Site director	Inventory	0:30
AUTOMOTIVE	LOGISTICS SERVICE PROVIDER 2	Planner	Procurement	0:30
		Planner	Procurement	0:30
		Items administrator	Procurement	0:30
		Items administrator	Procurement	0:30
	MANUFACTURER 4	Logistics manager	Distribution	0:45
		Kitting manager	Inventory management	0:45
	MANUFACTURER 5	Logistics and production manager	Procurement	1:00
		Flow manager	Procurement	0:30
	MANUFACTURER 6	Project procurement manager	Distribution	1:00
		IS Manager	IS	1:00

Table 2: Interviews details

3.2 Data analysis

Every interview was fully transcribed and analysed with the qualitative data analysis computer software NVivo 10. We used the coding methodology, which principle is to create categories and subcategories in which the researcher affects units of analysis from the data collected. (Huberman and Miles, 2002). Throughout the reading of interviews, we assign codes to undesirable effects that appear in the comments of respondents. First we got inspired by some of the variables of the fit (Goodhue, 1995) in its negative aspects. For example, Goodhue (1995) uses the variable "*data compatibility"* when it "*is necessary for users to compare or aggregate data from two or more sources*" (p.1842), We chose to use its negative version, that is to say *data incompatibility,* when equivalent data from different sources cannot be aggregated or compared. Consistent with our abductive approach some effects were revealed but could not be associated with pre-existing codes. To encode these relevant units of meaning, we created new codes. All our units of meaning were coded; we organized our codes using meta-categories according to thematic coding method. The meta-categories of undesirable effects were based on pre-existing typology of misfits.

	FOOD					AUTOMOTIVE			
APPLICATION	MAN. 1	MAN. 2	MAN. 3	DIST.	LOG. PROVIDER 1	MAN. 4	MAN. 5	MAN. 6	LOG. PROVIDER 2
EDI	X	X	X	X	X	X	X	X	X
ERP	X	X	X	X	X	X	X	X	X
GPAO		X		X	X				
WEB PORTAL	X	X		X	X				
APS	X	X							
TMS	X	X			X	X	X		X
WMS	X	X	X	X			X		X

Table 3: Applications involved in the companies

4 Research Findings

We identified twelve undesirable effects in our case studies that we organize in three categories that we describe in details below and synthetize in table 4. We illustrate each effect with a meaningful *verbatim* (translated from French).

4.1 The usability undesirable effects

Usability refers to the ease, manoeuvrability, and ergonomics of the application and summarizes some ease and comfort of use of the information system for users. The effects related to the lack of usability are due to "*heavy or confusing interactions with technology for the execution of tasks requiring additional non-value added steps or introducing trouble to enter or retrieve informati*on" (Strong and Volkoff, 2010, p.741). We find in the usability undesirable effects, the *learning difficulty*, the *multiplicity of applications* and the *features not mastered*. In other words, the usability effects cause:

- Reduced use of available applications (compared to full and normal use);
- Use requiring more operations than expected at the adoption of the information system;
- Use requiring more operations prior to the implementation of the information system.

The multiplicity of applications is due to the presence and the need to use a large number of applications to perform work tasks. This usability default may first depend on the implementation strategy of the information system, which is not always the result of a comprehensive standardized computerization. The implementation may be the result of a "*best-of-breed*" strategy (the adoption of the best market product for a specific activity). The company is then equipped with multiple expert systems interfaced with each other or connected to a single database to meet the specific needs of each business. The implementation can also follow up on the decisions of timely adoption over partnerships or internal company growth. The multiplicity of interorganizational applications (customer or supplier) comes from the decision (imposed, encouraged or chosen) to adopt one or more technological applications to communicate automatically with other businesses upstream or downstream of the supply chain. These both types of implementation generate the undesirable effect that we call the *multiplicity of applications*. Due to the fact, that the applications are not only available in the organization, but are essential to the working tasks, this multiplicity makes daily activity more complex to IS users.

META-CATEGORY AND GENERAL CONSEQUENCES	CODING	*VERBATIM*
USABILITY EFFECT (The use of the information system is reduced or complexed)	**Learning difficulty***	*"For me the qualities of a good buyer , is someone who is quite adaptable to IT. It necessarily requires computer skills and know how to pass from an information system to another . (...) So initially when someone starts from zero , it takes a month of training. It depends of course of the people but you have to grab our tools, they are specific to our company and most have been developed internally. "*
	Multiplicity of applications	*" It's too complicated today. Three commercial management tools. It's complicated for managers because it takes from three different screens. They use three tools, it is difficult in terms of consolidation of information, in terms of coding, in terms of process because each tool has a different way, different approach to billing, discounts, pricing...*
	Features not mastered	*"I confess that I am not using this function at all , but it seems to me that if we want to order something , it will provide the information of the lead-time ... I do not even know if what I say is true ... as I do not use it . I trying but it does not seem to work ... not show anything. Because I think at one point he should tell us there was this possibility on the control period ... "*
FUNCTIONALITY EFFECT (The features of the information system are not available to the user)	**System technical unreliability***	*"Yes, because there may have Wifi problems steering (...) and as we are on lean management , we are on fresh products, 90% of orders , we have the morning to make them leave the same day. We receive customer orders at 9 commands that will leave at 12:30 ».*
	Inadequate timeliness*	*"Today the big problem we still have is the slowness of the tool still (...) The programs are not optimized , so there are many calculations that are done and slow down the response. "*
	Inadequate support responsiveness*	*"The IT support is at the headquarters . So we work with emergency request. It's not very convenient to have an IT department far enough , especially even when there are concerns , it often fails (...) . We cannot do anything here. And they are also at the headquarter, so they will inevitably tend to troubleshoot them faster than someone working here. It's human."*
DATA EFFECT (Data are not available when users need)	**Data incompatibility***	*"There are products, materials that we manages by kilos and others by parts. The problem is that the system does not make us for products parts... there is no possible extraction that gives us the weight."*
	Lack of data traceability*	*"No, until the arrival at the warehouse , it is they (buyers) who manage the floating cargo. They manage the floating cargo because currently this is another system called narius. It was too complicated to manage the floating cargo in the ERP. It would have made a lot of manipulations . Information is received on the ERP, that from the moment it enters an external warehouse or here. "*
	Difficult data accessibility*	*"We have a mechanized tool that generates information , data, anomalies messages, but behind it is unclear how to exploit it because we have no access to data. There is no data , so yes anomalies, one knows that one has , how much, where, how, why ? We do not know. "*
	Data synchronization default	*"The fact of being multi-tools interfaced it is true that it has its limits too. Because it has its limitations and constraints , that is to say, when you want to move to a customer request information in the system, it is necessary that all other systems follow. So it's true that it's complicated. There is always the problem of real-time that is not necessarily there in management tools."*
	Poor quality of information	*"And here , unfortunately for the same item we have ... the same article, a shrimp with a class , we will have six or seven origins. So that the system would not be able ... well he would be able ... but the one we have now is not able to manage this different information."*
	Lack of data security	*"So they lost a part of their history in terms of forecasting sales and then spend hours telling the client ... before that replaced it , they do not even have data that bursts on two levels "*

* Adapted variables from Goodhue, 1995, Strong & Volkoff, 2010.

Table 4: The 12 undesirable effects observed from the case studies.

The learning difficulty seems to be a direct consequence of the multiplicity of applications. Users should be trained in several applications to work properly and perform all their tasks. This difficulty increases the time and complexity of training and makes internal mobility or replacement of the staff sensitive for the proper functioning of the activity.

The features not mastered mean that users do not use all the available features in the information system even if they are aware of their availability. This effect refers to the proficient usage (Veiga and al., 2013), which implies not only that the individual uses the information system but also employs all applications from the information system aimed to facilitate and promote its performance on its tasks. This failure in the use of applications mainly comes from the effect of the *learning difficulty* but also from a lack of training on applications. The applications features that are not used generate additional manual tasks that could be avoided in a proficient usage.

4.2 The functionality undesirable effects

The effects related to the functionality of the information system are defined as "*leading to reductions in effectiveness or efficiency compared to the results before the implementation of the information system*" (Strong and Volkoff, 2010, p.737). The functionality is a concept present in the literature based on the construct of fit and usually observed at the task level (Goodhue, 1995; Goodhue and Thompson, 1995; Goodhue, 1998). All the respondents in organizations perceive undesirable effects in the use of technology to carry out their work tasks. The term functionality here refers to technical undesirable effects. The technical nature of the effects is defined by concrete malfunctions in the technical infrastructure of the information system, mainly in the computer networks, telecommunications and Internet, but also a lack of responsiveness on the resolution of these problems through IT service support. The functional effects include the *system technical unreliability*, *inadequate timeliness* and *inadequate IT supports responsiveness*. The effects on functionality generate more or less temporary, unavailability of the information system features for users. Consequently, the tasks carried out through the information system, are slow, interrupted or postponed.

The system technical unreliability means that respondents often question the lack of technical reliability of the information system, which is due to the interruption of the computer network connection, telecommunication or the Internet. If this interruption does not appear to be extremely frequent, the consequence of that failure is usually very heavy. The continuity of the organization activity is then undermined and sometimes requires a temporary stoppage of work. Users no longer have access to information and applications, which stops *de facto* the performance of their tasks related directly to the information system. Sometimes the application remains accessible and provides data visualization, but it does no longer respond, hindering by the fact the users' activity.

Inadequate timeliness refers to an unsatisfactory response time of the information system about the task that the user should perform. Goodhue and Thompson (1995) identify the production timeliness as a contributing element for the fit. Therefore it is in their work an objective rather than a consequence. The negative consequence refers to the execution speed, which is degraded compared to a previous state or a normal state for the user. In other words, users cannot use their dedicated applications as it is usually expected. The timeliness is important in an interorganizational context, even more in a management in just-in-time, which implies continuous information flow. Indeed, this response time is essential in the execution of interdependent tasks. In the context of the logistics process, most tasks are inter-connected with each other within the organization or with customers or suppliers. The slowdown in the execution of one of them slows down all downstream tasks. For example if access to customer orders is not available, this may delay order preparation and delivery to the customer. Companies of our case studies are in just-in-time flow, which makes even more important the system responsiveness. The inadequate timeliness of the information system is in our context due to different factors according to the organization studied.

- The increasing number of simultaneous users for the same application can slow down the response;

- The necessary interfaces between a growing number of applications can generate new IT operations to make them communicate with each other and increase the response time;
- The aging applications that take more and more time to respond.

The inadequate IT support responsiveness reflects the inability for users to solve their own difficulties in using the information system. Goodhue and Thompson (1995) also describe a variable referring to the reactivity of the information system support but they focus on aspects of training on the applications. We discuss here rather the aspect of troubleshooting and response to the user on technical problems encountered during the use of the information system. The support function related to information system (Information systems management, internal hotline, developer hotline) is then perceived not enough available or responsive for the users. The difficulties of the user in the use of the information system may involve an inability to get access to the totality of features and induces an inability to perform work tasks

4.3 The data undesirable effects

The categories on the data are identified in the literature, whether in the definition of some misfits (Strong and Volkoff, 2010), or in the variables of the fit (Goodhue, 1998). The undesirable effects on the data occur "*when data or data characteristics stored in or needed by the IS lead to data quality issues such as inaccuracy, inconsistent representations, inaccessibility, lack of timeliness, or inappropriateness for users' contexts*" (Strong and Volkoff, 2010, p.739). Goodhue and Thompson (1995) proposed the data quality variable (for right, timely and accurate data) and availability of data (for current and easily accessible data). However, some data effects mentioned by the respondents could not be linked to these pre-existing categories. The effects are sometimes the cause or the consequence of the other effects identified above. Moreover, our analysis throughout the whole logistics process in supply chains gives us a broader vision of effects and allows us considering the effects related to the lack of continuity and relevance of information between organizations. So we add the effects due to the *lack of traceability*, the *synchronization default,* and *the lack of data security* to the *data incompatibility,* the *difficult data accessibility,* and the *poor quality of information*.

The data incompatibility refers to the presence of equivalent data from different sources that cannot be compared or aggregated together as they are defined differently (for example, the products can be described in the various applications in distinct units or in a different level of detail). This incompatibility can be observed at the intra-organizational level between two internal applications, or at the interorganizational level between different organizations or applications that exchange or make available information for users from different companies.

The lack of traceability means that the data are not tracked throughout the whole logistics process. The data are inaccessible to a point in the process where they are necessary for the activity, and sometimes must be re-entered. The lack of traceability mostly involves a complete break of the information flow. However, the lack of traceability is not always due to the discontinuity of information, but may also result from partial loss of information when transmitted to another application, such as transmitted at different level of detail.

The data synchronization default of real time data refers to the lack of synchronization between the data of the actual situation and the data represented in the application. For example, the synchronization cannot produce information on the current number of items in stock, which makes it different from the actual items number in stock. The supplier delivered some products but the application's update is not effective on this new stock entry. The lack of synchronization can be perceived internally between applications within the same organization or externally when data is exchanged in an interorganizational logistics process.

The difficult data accessibility refers to data in the information system that is difficult or impossible to view or extract for users. The difficulty to access the data harms the availability of information to us-

ers. This may be a result of temporary or permanent technical malfunction, or because of the multiplicity of applications that makes access complex or partial. The difficulty to access the data may also be due to a learning difficulty or a lack of access for some users according to the rules issued by the Information Systems Management.

The poor quality of information refers to the fact that the data in the application cannot be used in the execution of tasks in the format proposed by the interface. Wang and Strong (1996) define data quality as "*data that are fit for use by data consumer* " (p.6). In our case studies, users are talking about the data generating operational information. This information is related to routine business tasks for the management of daily operations. This operational information is to differentiate from strategic information needed for decision-making by the company's managers. The poor quality of information means that the format of the information does not have the sufficient level of details to give useful information for users. For example, information of the total amount of raw material stock in the company is useful for financial purpose but is not sufficient for logistics activity, which rather uses the precise number of parts and their physical location. This effect can also refer to the lack of relevance of information that make them unsuitable for the activity, meaning the information available to the actor does not have value to its own business. Users perceive the effects regarding the value of information related to the nature of the data exchanged so the information does not have the same importance for all stakeholders. The quality of information in our research context means that the data must be of high quality in the context of their use for the task they support (Wang and Strong, 1996).

The lack of data security refers to either the inability to store data in a safe and sustainable way internally, or to the impossibility to transmit them to another company without a risk of loss or disclosure. Data security is related to the need of keeping a data history for the company (the sales data history in order to establish production forecasts). The data security can also refer to an obligation of compliance regarding standards, regulations or laws on the confidentiality of information.

	FOOD					AUTOMOTIVE			
UNDESIRABLE EFFECT	MAN. 1	MAN. 2	MAN. 3	DIST.	LOG. PROVIDER 1	MAN. 4	MAN. 5	MAN. 6	LOG. PROVIDER 2
Learning difficulty			X	X					
Multiplicity of applications	X	X	X	X					
Features not mastered				X					
System technical unreliability		X							
Inadequate timeliness	X	X	X	X				X	
Inadequate support responsiveness	X		X	X	X		X		
Data incompatibility	X	X	X	X	X			X	
Lack of data traceability					X				
Difficult data accessibility			X	X				X	X
Data synchronization default	X		X	X				X	
Poor quality of information	X	X	X			X	X	X	X
Lack of data security			X						

Table 5: Undesirable effects coding regarding the companies

5 Discussion

5.1 Interorganizational undesirable effects

Fichman (2004) emphasizes that little research is concerned with long-term consequences of the adoption of applications. Yet an assessment of the technology adoption demonstrating its benefits, cannot exclude that its adoption and use through the time by other organizations can lead to different results. Integrated applications that are used within and across organizations in an interorganizational context add complexity to the fit due to the strong interdependence between the tasks and IS, which generate in our case studies new negative consequences. In the light of our observations and our analysis of the

effects, we synthesize below (Cf. table 6 and 7). 1/ The nature of undesirable effects is different regarding the type of functional integration of the organisation studied. The diversity of effects does not decrease with a higher level of functional integration. It seems that different types of integration generate different types of effects. 2/ effects observed are different if they are linked to an internal application (intra-organizational) or to a shared application to support the process logistics with suppliers or customers (interorganizational). We can observe the effects on the functionality of the information system (*system technical unreliability*, *inadequate timeliness* and *inadequate support responsiveness*) refer exclusively to internal applications. The effects on the usability of the information system are firstly related to internal applications, but also to applications connected externally (*multiplicity of applications* and *use difficulty*). The effects on the data are both found on internal or interorganizational applications.

Four of the undesirable effects that emerge from our analysis (*the multiplicity of applications*, *lack of data traceability*, *data synchronization default* and *lack data security*) are directly related to the use of applications that support the interorganizational process. Only the emergent effect of *the features not mastered* is observed in intra-organizational applications. These undesirable effects are original and come from the use of different features related to interorganizational process, and therefore the sharing and the provision of information between multiple organizations. These undesirable effects are present in the use of interorganizational applications, which are not studied in the papers that mobilize the fit and the misfit. Furthermore we should notice that all effects identified except from the one of *use difficulty* are present in the ERP and EDI usage.

TYPES OF FUNCTIONAL INTEGRATION	UNDESIRABLE EFFECTS
Transactional	Data incompatibility Multiplicity of applications System technical unreliability Poor quality of information
Informational	Difficult data accessibility
Collaborative	Data incompatibility Multiplicity of applications Learning difficulty Inadequate timeliness Poor quality of information

Table 6: Common observed effects to both case studies regarding the type of functional integration

5.2 Misfit typology extension

The information system is apprehended in our research in terms of its materiality and its features. The undesirable effects studied at the individual level are operational. The typology of misfits (Strong and Volkoff, 2010) proposed a categorization of misfits that allows describing misfits. However, their analysis is placed at the organizational level and we aim to detail the operational misfits by the users' perceptions. Building on the variables of the fit and developing the notion of undesirable effect, we propose an extension of the typology of misfits (Cf. Table 4). We rely on the typology of Strong and Volkoff (2010) but we do not mobilize the categories referring to misfits of role, culture and control. However we observe the undesirable effects misfits of functionality, usability and data, which achieve a higher level of detail and consider the negative consequences of the use of the system information for individuals. This level of detail is sometimes present in respondents' words in Strong and Volkoff (2010) article. Nevertheless the authors do not identify precisely the effects, preferring an aggregate

and organizational level. We believe that this level of accuracy of effects allow a better understanding of the phenomenon of undesirable effects and above all of the usage of IS.

CODING		Intra-organizational	Interorganizational
Adapted from the literature (*Goodhue and Thompson, 1995, Strong and Volkoff, 2010*)	**Learning difficulty**	Other	Web portal
	System technichal unreliability	ERP	
	Inadequate timeliness	ERP	
	Inadequate support responsiveness	ERP / MRP	
	Date incompatibility	ERP / MRP	EDI / Web portal
	Poor quality of information	ERP / MRP	
	Difficult data accessibility	ERP / MRP	
Emerged from the field data	**Multiplicity of applications**	ERP	Web portal
	Features not mastered	ERP / other	
	Lack of data traceability		EDI / TMS
	Data synchronization default	ERP	WMS / TMS
	Lack of data security		EDI / TMS

Table 7: Applications related to undesirable effects and their scope of application

6 Conclusion, limitations and future research

This research aims to identify and assess the negative consequences from the use of integrated information systems in an interorganizational context for the individuals. We developed the notion of undesirable effects to analyse the users' negative perception about the IS. Users consider the effects undesirable when they harm or bind the performance of their activity. The results of our research provide empirical evidence to identify twelve undesirable effects for individuals in the context of supply chains. Four of them are closely related to the use of interorganizational applications and emerged from the field data, while others are mentioned in previous articles. Nevertheless all the effects appear to be interdependent and even imply causality relationships between them. Eventually, undesirable effects provide new insight on usage consequences, contribute to the literature on the evaluation of interorganizational information system and extend the typology of misfits (Strong and Volkoff, 2010).

The limits of our research mainly lie in the choice of our sample and data collection. The sample covers two very different industries, whose common characteristic is their management of the supply chain logistics flow in just-in-time. This management type has the advantage to accentuate the effects visibility. However, we recognize that the choice of this type of management defines our research on a specific type of organization. Further research could collect data in supply chains, which less demanding management type. This different sample choice would have the advantage of taking into account or excluding the influence of just-in-time in the presence of undesirable effects.

This research has also focused on user perceptions to assess the consequences of the use of logistics applications for the execution of their tasks. This choice of users as evaluators is justified by the privileged position of the respondents directly interacting with applications. But this choice has some limitations; the main one is to be able to distinguish between the undesirable effects that are within the

application and those under the characteristics of the individual (skills, appetence for technology, etc.) However, this individual evaluation brings anyway new insights about the effect of logistics integration. The undesirable effects identification should help the managers to choose their alignment strategy during the phase of routine use of the information system. The inevitable questions of the information system alignment (such as the choice of technology adoption or adaptation of business processes) as well as the expected impact on organizational performance can not be fully understood at the users level. Consideration from the viewpoint of other organizational actors as managers or independent audits based on observation could help to integrate such questions.

Moreover, the results of our research identify undesirable effects interactions between internal or external applications. The interactions between applications are usually generated when new organizational needs the adoption of new applications or the implementation of exchange of information with customers or suppliers. The evaluation of the information system in the use phase allows identifying these effects for users and providing vigilance elements for managers in integrating new applications. The question arises for managers to be able to articulate the local alignment of information system and that for all organizations in the supply chain. The emergence of sustainable development, involving the consideration of impacts on stakeholders, policymakers should encourage firms to adopt in the evaluation of the information system, the negative effects generated from their customers or suppliers. Further research could then tend to assess the good balance of positive and negative consequence of the use of integrated IS within the organization but also considering the partners within supply chain.

References

Auramo, J., J. Kauremaa, K. Tanskanen (2005). “Benefits of IT in supply chain management: an explorative study of progressive companies”. *International Journal of Physical Distribution & Logistics Management* 35(2), 82–100.

Bidan, M., F. Rowe, D. Truex (2012). “An empirical study of IS architectures in French SMEs: integration approaches”. *European Journal of Information Systems* 21(3), 287–302.

Clemons, E. K., S. P. Reddi, M. C. Row (1993). “The impact of information technology on the organization of economic activity: The“ move to the middle” hypothesis”. *Journal of management information systems* 10, 9–35.

Cooper, R. B., R. W. Zmud (1990). “Information technology implementation research: a technological diffusion approach”. *Management science* 36 (2), 123–139.

De Corbière F., Rowe F., F_C. Wolff (2012). “De l’intégration interne du système d’information à l’intégration du système d’information de la chaîne logistique", Systèmes d’information & management 17(1), 81-111.

De Corbiere, F., F. Rowe (2013). “From ideal data synchronization to hybrid forms of interconnections: architectures, processes, and data”. *Journal of the Association for Information Systems* 14(10), 550–584.

De Corbière, F., Takeda, H., Habib, J., Rowe, F., D. Thiel (2016). “A simulation approach for analyzing the influence of information quality on the deployment of a green supply chain”. In ECIS 2016.

Fichman, R. G. (2000). “Going beyond the dominant paradigm for information technology innovation research: Emerging concepts and methods”. *Journal of the association for information systems* 5 (8), 314-356.

Gebauer, J., M. J.Shaw, M. L. Gribbins (2010). “Task-technology fit for mobile information systems”. *Journal of Information technology* 25 (3), 259–272.

Giachetti, R. E. (2004). “A framework to review the information integration of the enterprise”. *International Journal of Production Research*, 42(6), 1147–1166.

Goodhue, D. L. (1998). "Development and Measurement Validity of a Task-Technology Fit Instrument for User Evaluations of Information System". *Decision Sciences* 29 (1), 105–138.

Goodhue, D. L., R. L. Thompson (1995). "Task-Technology Fit and Individual Performance". *MIS Quarterly* 19 (2), 213–236.

Grover, V., K. A. Saeed (2007). "The Impact of Product, Market, and Relationship Characteristics on Interorganizational System Integration in Manufacturer-Supplier Dyads". *Journal of Management Information Systems* 23 (4), 185–216.

Gunasekaran, A., E. W. T. Ngai (2004). "Information systems in supply chain integration and management". *European Journal of Operational Research* 159 (2), 269–295.

Huberman, M., M. B. Miles (2002). *The qualitative researcher's companion*. Sage.

Im, G., A. Rai (2013). "IT-Enabled Coordination for Ambidextrous Interorganizational Relationships". *Information Systems Research* 25 (1), 72–92.

Inman R.A., Brandon L.D. (1992). "An undesirable effect of JIT", Production and Inventory Management Journal" 33(1), 55.

Kärkkäinen, M., S. Laukkanen, S. Sarpola, K. Kemppainen (2007). "Roles of interfirm information systems in supply chain management". *International Journal of Physical Distribution & Logistics Management* 37 (4), 264–286.

Klein, R., A. Rai (2009). "Interfirm Strategic Information Flows in Logistics Supply Chain Relationships". *MIS Quarterly* 33 (4), 735–762.

Maiga, A. S., Nilsson, A., Ax, C. (2015). "Relationships between internal and external information systems integration, cost and quality performance, and firm profitability". *International Journal of Production Economics* 169, 422-434.

Maurer, C., N. Berente, D. Goodhue (2012). "Are Enterprise System Related Misfits Always a Bad Thing?". *45th Hawaii International Conference on System Science* (HICSS), 4652–466.

Mithas S., Tafti A.R., Bardhan I. & Goh J.M. (2012). "Information technology and firm profitability: mechanisms and empirical evidence". *MIS Quarterly* 36(1), 205–224.

Orlikowski, W. J. (1996). "Improvising organizational transformation over time: A situated change perspective*". Information systems research* 7(1), 63–92.

Prajogo, D., J. Olhager (2012). "Supply chain integration and performance: The effects of long-term relationships, information technology and sharing, and logistics integration". *International Journal of Production Economics* 135 (1), 514–522.

Rai, A., R. Patnayakuni, N. Seth (2006). "Firm performance impacts of digitally enabled supply chain integration capabilities". *MIS quarterly* 30 (2), 225–246.

Robey, D., M-C. Boudreau. (1999). "Accounting for the Contradictory Organizational Consequences of Information Technology: Theoretical Directions and Methodological Implications". *Information Systems Research* 10(2), 167–185.

Robey, D., G. Im, J. Wareham (2008). "Theoretical Foundations of Empirical Research on Interorganizational Systems: Assessing Past Contributions and Guiding Future Directions". *Journal of the Association for Information Systems* 9 (9), 497-518.

Saeed K.A., Malhotra M.K. & Grover V. (2011). "Interorganizational system characteristics and supply chain integration: an empirical assessment", Decision Sciences 42(1) 7-42.

Saeed, K. A., S. Abdinnour (2013). "Understanding post-adoption IS usage stages: an empirical assessment of self-service information systems". *Information Systems Journal* 23 (3), 219–244.

Sanders, N. R., R. Premus (2002). "IT Applications in Supply Chain Organizations: A Link Between Competitive Priorities and Organizational Benefits". *Journal of Business Logistics* 23(1), 65–83.

Seddon, P. B., C. Calvert, S. Yang (2010). "A Multi-Project Model of Key Factors Affecting Organizational Benefits from Enterprise Systems". *MIS Quarterly* 34 (2), 305–328.

Sia, S. K., C. Soh (2007). "An assessment of package–organisation misalignment: institutional and ontological structures". *European Journal of Information Systems* 16 (5), 568–583.

Soh, C., S. Kien Sia, W. Fong Boh, M. Tang (2003). "Misalignments in ERP implementation: a dialectic perspective". *International Journal of Human-Computer Interaction* 16 (1), 81–100.

Strong, D. M., O. Volkoff (2010). "Understanding Organization-Enterprise System Fit: A Path to Theorizing the Information Technology Artifact". *MIS Quarterly* 34 (4), 731–756.

Veiga, J. F., M. M. Keupp, S. W. Floyd, F. W. Kellermanns (2013). "The longitudinal impact of enterprise system users' pre-adoption expectations and organizational support on post-adoption proficient usage". *European Journal of Information Syst*em, 23 (6), 691-707

Wang, E. T. G., J. C. F. Tai, V. Grover (2013). "Examining the Relational Benefits of Improved Inter-firm Information Processing Capability in Buyer-Supplier Dyads". *MIS Quarterly* 37 (1), 149–173.

Wang, E. T. G., Tai, J. C. F., H-L. Wei (2006). "A Virtual Integration Theory of Improved Supply-Chain Performance". *Journal of Management Information Systems* 23 (2), 41–64.

Wang, R. Y., D. M. Strong (1996). "Beyond accuracy: What data quality means to data consumers". *Journal of management information systems,* 5–33.

Wynn D. et Williams C.K. (2012). "Principles for conducting critical realist case study research in information systems ". *MIS Quarterly* 36(3), 787-810.