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Promoting the Integration and Use of an Industry IOIS: an Action-Oriented Perspective

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Abstract

The main reason for the failure of an industry inter-organizational information system (IOIS) is the low rate of adoption and use of the IOIS. Literature on IOIS has proposed primarily factor-based models to explain the adoption decision or the extent of use. In this paper we argue that a processual view is lacking for IOIS literature. We conduct a case study of an industry IOIS at the Seaport of Barcelona, which supports the message exchanges among the port agents operating in the Seaport. Using grounded theory research approach, we conceptualize the strategies adopted by managers of the IOIS in order to promote the integration of port agents' systems with the IOIS and its further use. We then use action-oriented diagrams to structure and report on those strategies. Finally, drawing on mutual adaptation literature, we regard those strategies as adaptations to conform to three types of misalignments: technical, delivery system and value.

Keywords: IOIS, Integration, Use, Adaptation, Grounded Theory, Action-Oriented Diagram

1 Introduction

An industry inter-organizational information system (IOIS) is a type of system that it is set up, organized and used by firms of the same industry. The main reason for the failure of an industry IOIS is that firms of the industry do not adopt or use it. Although literature on IOIS is extensive, it has mainly proposed factor-based models that explain the non-adoption decision or the extent of use of the IOIS, but has rarely tackled its processual nature (Rodon 2006).

This paper is in line with Robey's call for use of inductive theory building to examine "how IT is used, not whether it is adopted or not" (Robey 2003). Instead of focusing on factors that determine the adoption and use of IOIS, we focus on the actions that are performed when certain conditions –i.e. problems in the use of the system– are present and their consequences. Such actions influence how the

technology is put to use. This research follows the principles of grounded theory as developed by Strauss and Corbin (1998). In addition, we use action-oriented diagrams (Axelsson and Goldkuhl 2004) to report on the strategies adopted to promote the integration of pre-existing systems with an industry IOIS and its further use. Those strategies are deliberate or purposeful acts that are taken to resolve a problem –i.e. non-use– and, in doing so, change the conditions and the phenomenon in some way (Strauss and Corbin 1998). These problems owe to misalignments between the IOIS and the adopters' systems, business processes, interests, etc. These strategies may serve as a guide for practitioners.

The structure of the paper is as follows. We first review the literature on IOIS implementation and use, and on action-oriented perspectives next. We then present the research methodology. The next section introduces the background of the case study, followed by the results. The discussion section integrates the results with insights from mutual adaptation literature. Finally the paper presents the contributions and conclusions.

2 Literature review

2.1 Literature on IOIS

Diffusion of innovations (Rogers 1995) has been widely applied in the study of IS implementation in organizational (Cooper and Zmud 1990;Kwon and Zmud 1987) as well as inter-organizational contexts (Iacovou et. al. 1995;Premkumar and Ramamurthy 1995). These studies have mainly proposed factors-based models for IOIS adoption, implementation and use. Some authors, however, give arguments against such models and propose that the study of IOIS requires us to focus on critical process features (Kurnia and Johnston 2000;Lyytinen and Damsgaard 2001). Such a processual view allows us to provide explanations of reality in terms of sequence of events, activities and choices leading to an outcome that describe how things change during the duration of the phenomenon –i.e. IOIS implementation (Markus and Robey 1988).

There is some research on IOIS, which has viewed the integration of EDI with internal systems as a set of recurring phases, where each phase means more integration indicating more control and more efficiency (Angeles and Nath 2000;Swatman et. al. 1994). This research however, conceptualizes the

process as a set of stages, but not in terms of sequences or shifts in the nature of action. On the other hand, literature on IOIS use is inspired by the work of Massetti and Zmud (1996) who conceptualize the extent of IOIS use as having four precursors: volume, breadth, diversity, and depth. This conceptualization, however, does not tackle the processual nature of use we adopt in this paper.

2.2 Action-oriented perspective

In line with Lyytinen & Damsgaard (2001) and Kurnia & Johnston (2000) we regard that success or failure in IOIS implementation cannot be explained with a fix set of independent factors; rather, complex dynamics and processes that involve different actors (people, technologies, standards, rules) may better explain success or failure. These authors argue that research on IOIS requires contextual studies and the adoption of a processual view that places emphasis on the interaction of technology and organizations (Kurnia and Johnston 2000;Lyytinen and Damsgaard 2001). Such a processual view allows us to provide explanations of reality in terms of sequence of events, activities and choices leading to an outcome that describe how things change during the duration of the phenomenon –i.e. IOIS implementation (Markus and Robey 1988).

Grounded theorists call for theories that take account of basic social processes, which are summaries of the patterned, systematic uniformity of social life which people experience (Goulding 2002). Symbolic interactionism asserts that "the essence of society lies in an ongoing process of action, not in a posited structure of relations. Without action, any structure of relations between people is meaningless. To be understood, a society must be seen and grasped in terms of the action that compromises it" (Blumer 1969, p.71). Accordingly, action-oriented frameworks are adequate instruments for the creation of knowledge with practical value (Agerfalk et. al. 2006). Grounded theorists (Strauss and Corbin 1998), who were strongly influenced by interactionist and pragmatist writings, propose an action-paradigm model to explain a phenomenon in terms of conditions, actions and consequences. According to Strauss and Corbin (1998), in studying a phenomenon "we are looking for repeated patterns of happenings, events, or actions/interactions that represent what people do or say…, in response to the problems and situations in which they find themselves" (Strauss and Corbin 1998, p.130).

This paper complements prior IOIS literature by adopting a process view, more specifically an action-oriented perspective. We conceptualize the process in terms of sequences or shifts in the nature of action, instead of a set of stages. In addition, we use an inductive theory discovery methodology, such as grounded theory, to develop a set of action-oriented diagrams that conceptualize the strategies adopted to promote the integration and use of an industry IOIS.

3 Research Methodology

We regard the use of grounded theory to be appropriate in this study for the following reasons: 1) it allows the researcher to find process in data (Strauss and Corbin 1998); 2) it has a set of established guidelines both for conducting research and for interpreting the data which offer a sense of security when delving into the unknown territory that becomes the research (Goulding 2002); 3) it is an interpretivist mode of enquiry that has its roots in symbolic interactionism (Blumer 1969); and 4) it is an established and credible methodology in the IS field (Crook and Kumar 1998;Orlikowski 1993).

Strauss and Corbin (1998) state that grounded theory is "an action/interactional method of theory building". Accordingly, the authors suggest an action paradigm model consisting of conditions-actions/interactions-consequences. This paradigm model is an analytical tool to integrate the conditions or structure, in which categories are situated, with the sequences of action/interaction processes that pertain to the phenomenon. Such action/interaction processes "occur over time and space, changing or sometimes remaining the same in response to the situation or context… Action/interaction evolves or can change in response to shifts in the context. In turn, action/interaction can bring about changes in the context, thus becoming part of the conditions framing the next action/interactional sequence" (Strauss and Corbin 1998, p.165).

3.1 Data collection and analysis

Our research relies upon an interpretive case study (Walsham 1995) carried out in the Port of Barcelona. The empirical work was conducted by the first author over a 9-month period (March 2005-November 2005). Data collection consisted of semi-structured interviews, meeting minutes, document analysis, company visits, and attending meetings. Over 27 interviews were conducted, each about 1 hour long.

Type of firms	#Firms	#Interviews	Position
Shipping agent	2	6	CEO, IS manager and developer, Operations manager, user
Freight forwarder	4	6	Maritime manager, IS manager and developer, user
Inland terminal	1	3	CEO, Operations manager, IS developer
Hauler	2	4	CEO, Operations manager, IS developer
Port Authority	1	3	IS manager, Analyst, IS developer
IOIS	1	5	CEO, IS manager, Analyst, IS developers

Table 1: Summary of the interviews conducted

Consistent with grounded theory approach, our data collection, coding and analysis occurred iteratively. As interviews were transcribed they were coded and analyzed. This process gave new insights into the research, helped to formulate new questions in subsequent interviews and guided us on the most appropriate informants.

The coding-for-process approach (Strauss and Corbin 1998) inspired our data analysis. At first, data were examined line by line and coded based on the terms used by informants (open coding). Memos were also written and codes were grouped and organized into trees.

3.2 Theory modeling

In grounded theory the illustration of the theory is done during axial coding when categories are created and related. During axial coding, the researcher develops a category by specifying the conditions that gave rise to it, the context in which it is handled, managed and carried out. These conditions, contexts, strategies and outcomes tend to be clustered together and the connections may be hierarchical, linear or recursive (Goulding 2002). Although Strauss and Corbin (1998) suggest the use of diagrams, they “are not systematically shaped and not built in the methodology in a proper way” (Axelsson and Goldkuhl 2004). In order to make up for grounded theory’s lack of illustration techniques we use action-oriented diagrams (Axelsson and Goldkuhl 2004), which are a way to present the theory.

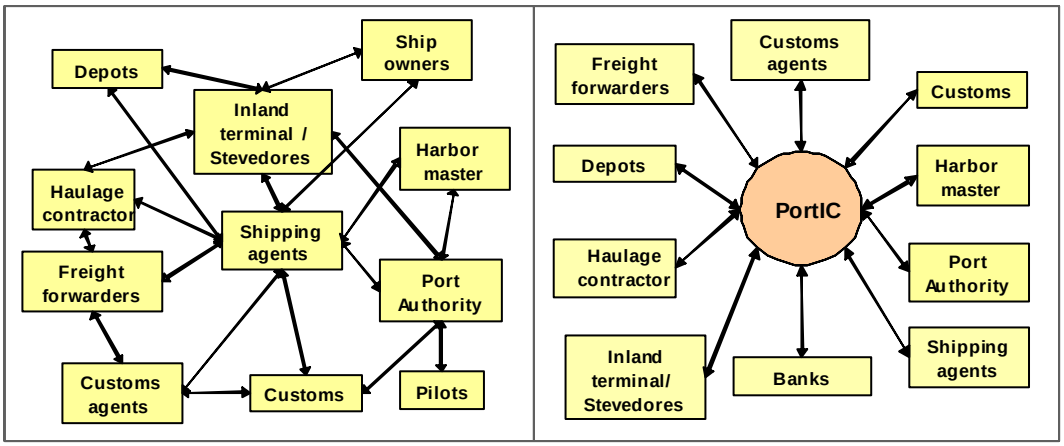
During the axial coding process we identified five main categories, which we interpreted as strategies adopted by the managers of PortIC to promote the integration and use of the IOIS. Then we structured the categories into action-oriented diagrams (Axelsson and Goldkuhl 2004). Different categorical phenomena were related to each other as causal-pragmatic relations in contextual action-

oriented diagrams. This means that the links between the different categories in the diagrams are not deterministic, rather they are the result or interpretations of the actors (Axelsson and Goldkuhl 2004).

In the diagrams, we use different labels to indicate the role of each category within the diagram, such as preconditions, actions, and effects. Effects may be intended and unintended. An unintended effect arises when an action that is performed with the intention of producing one effect produces a different one (either conflicting, negative or positive, result). On the other hand, effects may be primary and secondary. A primary effect might cause the secondary effect.

4 Case background

PortIC is an IOIS at the Port of Barcelona that was launched by mid-1999 in order to coordinate the activity of the firms in the port's landside transport network (which encompasses the transport of goods between the port and any place in the hinterland, and vice versa) and to integrate all the information being exchanged between the various port agents (see Figure 1).



Before PortIC With PortIC

Figure 1: Envisioned scenario for PortIC

In the envisioned scenario, PortIC would: 1) implement the standard for data exchange previously defined by TelFor[1]; 2) capture the information produced in any exchange within the port community, thus avoiding the need to retype data, substituting paper, and reducing the errors and processing costs;

[1] TelFor (Telemàtic Fòrum) is an standardization committee for the inter-organizational processes with the Seaport Community of Barcelona. In addition, to standardizing the inter-organizational processes, TelFor designs the EDIFACT messages corresponding to the documents exchanged in those processes. All the organizations, public and private, at the community are represented at TelFor.

3) centralize all the information of the port community; and 4) provide transparency and real-time information to facilitate the documentary track and trace of goods and reveal inefficiencies.

PortIC was characterized by the fact that it was owned and used by the port industry itself (the Port Authority, as well as private companies represented by their trade associations: stevedores, freight forwarders, clearing agents, shipping agents and Chamber of Commerce of Barcelona). These same industry stakeholders set up a company, namely Portic Barcelona, SA (PortICCO), in 1999 to manage the operation of PortIC. The company offered the following services: 1) private-to-public exchanges: exchanges between a private organization and a public body (i.e. cargo manifests, customs request, etc); 2) private-to-private exchanges (see Appendix A for the list of messages and workflows); 3) real-time information services that allow the documentary track and trace of goods.

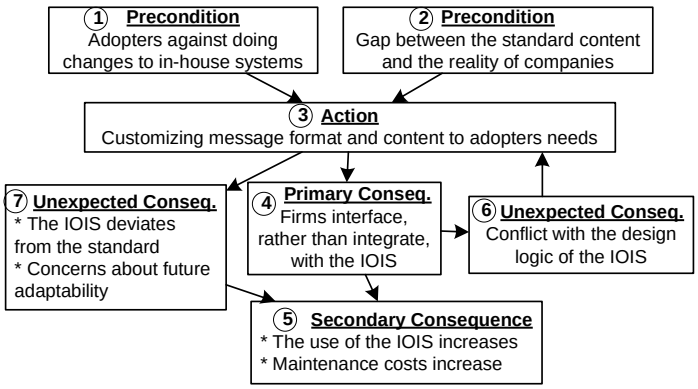
From the outset in 2000, the rate and extent of use of PortIC was far from satisfactory. It took adopters much more time than promoters expected to integrate and use the IOIS. Next we present the five strategies that PortIC management performed, during the period 2001-2005, in order to boost the integration and use of PortIC. For each strategy we provide a textual and a graphical (in the form of action-oriented diagrams) description.

5 Research Results

5.1 Strategy 1: Maintaining adopters' autonomy

There was a common belief among the promoters of PortIC that adopters would introduce organizational changes to take advantage of PortIC when they integrated with it.

> "PortIC is a system that is easy for companies to use. But this does not prevent the fear of the unknown in the form of internal change and a change in the way we think about our daily activity" (CEO of the PAB)



1 and 2. Preconditions. However, most of the firms in the study merely saw PortIC as a glorified postman, receiving messages and forwarding them on to the right target. From the

outset, the organizations in the study did not introduce changes in their organizational structures, and avoided making changes in their internal physical and documentary processes. They saw PortIC as a tool that simply replaced the fax or former EDI systems they had, and they were not willing to implement any change to their business processes. Moreover, some firms complained about the flows and content of some of the messages initially defined in the standard by TelFor and implemented by PortIC. They considered those business processes differed from their in-house business processes.

3. Action. Then TelFor and PortICCO decided that the standard and PortIC would adapt to the demands of adopters. For instance, in the case of exports, TelFor members agreed that truck drivers would not need to show any paper-based documentation to enter the inland terminal providing that the hauler had previously specified the driver in electronically submitted 'pre-arrival notification'. However, once PortIC had implemented the procedure, inland terminals objected to it arguing they had never worked that way. Then PortIC made some changes, which lay outside FortTel's scope, to persuade inland terminals.

> "There was initial resistance from inland terminals to accept this procedure. They argued that with the 'acceptance order' message was enough. But that means that the truck driver will have to bring a paper-based copy of the 'acceptance order'. Finally we agreed with inland terminals that haulers could submit the 'pre-arrival notification' and that PortIC would translate that message into the 'acceptance order' format before submitting it to the inland terminal… In that way the inland terminal did not have to adopt a new procedure for pre-arrival notification messages." (a manager at PortIC who participates in ForTel)

4. Primary Consequence. This accommodation of PortIC to adopters needs allowed the latter to avoid having to make changes to their business processes and databases. Interoperability was mainly accomplished through conversion tables but never by changing their data models. A systems developer of an inland terminal noted,

> "we use the call-sign to identify a vessel. PortIC, however, uses the Lloyds number. In the case of 'acceptance order' I receive the Lloyds number from PortIC. Then I periodically upload the master tables of vessels from the Port Authority to our AS400 and cross those tables with ours, in order to retrieve the call-sign, and store it in our system."

5.- Secondary consequence. A secondary consequence of the action was that some firms, which had agreed to integrate with PortIC several years before but had never been active users, boosted the

use of the system. There was an increase in the number of messages exchanged. On the other hand, the maintenance costs of PortIC increased as more customizations were implemented.

6. Unexpected consequence. Once firms started interfacing with PortIC they realized they required information to complete messages that was not always stored in their databases. However, the design logic behind PortIC had been that of a virtual clearing house. PortIC stored data from incoming messages and forwarded them to the specified target. That meant that, in some cases, firms were forced to store data from incoming messages that they had never used before but that they required in order to complete a message they had to generate later. These firms considered that although from the outset they had agreed with the design logic of PortIC, they later realized it could have been different.

> "This design logic for PortIC seemed natural. The more information we receive the better for the whole workflow. That would reduce the problems of the exchanges. Nowadays I realize we do not need so much information". (IS developer of a hauler)

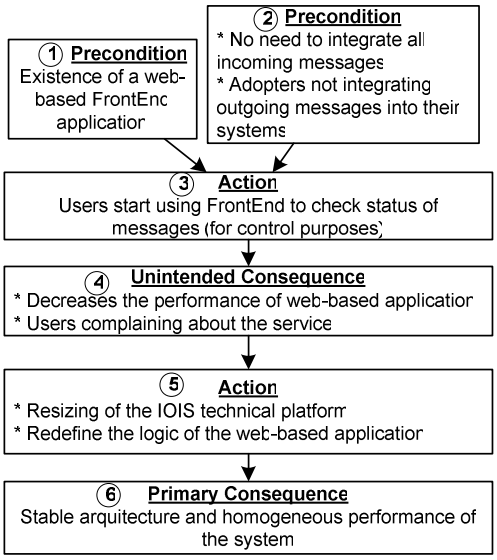
In such case, PortIC could add some value if it avoided firms having to retype some data that they did not have at that moment or which they had already previously sent (action 3). Later, PortIC accommodated to this requirement. For instance, an IS developer from an inland terminal notes,

> "When I send a 'gate-in notification' message, if that message corresponds to an 'acceptance order' of a dangerous good, the CODECO guide defined by EDIFACT forces me to use a free text within the GID segment. This bugs me, because I do not store free texts in our database. The fact that this free text field is compulsory makes no sense. In our business [inland terminal] this free text is of no use. Thus I have problems in generating the CODECO message…As PortIC had this free text in the database, they [PortIC] implemented a conversion table that allows me to get the free text through the 'acceptance order' identifier, which is in my database. We just send the 'acceptance order' identifier and PortIC does the conversion".

7. Unexpected consequence. Finally, as some of the changes introduced by the PortIC management had not been approved by TelFor, PortIC implemented some procedures that deviated from what the standard laid down. Moreover, the customization of the IOIS to current customers has diminished the capacity of the IOIS to adapt to future changes. In addition, PortIC's maintenance costs have increased (secondary consequence 5) given that any new measure approved by ForTel requires customization of PortIC support.

5.2 Strategy 2: Accommodating the IOIS to unintended uses

PortIC was designed in order to give every firm access regardless of the system they had in place.



1 and 2. Preconditions. Hence PortIC was based on the Internet: firms could send and receive messages in the formats defined by TelFor (EDIFACT, XML, and flat file) by using various services (ftp, oftp, e-mail). Users had the option of using a web-based application, namely FrontEnd, that ran on a PC and could be used for the generation and reception of messages. FrontEnd was intended for use by those companies that were unable to develop their applications to send and receive the messages from PortIC or by those who did not want to integrate their in-house systems with PortIC.

3. Action. However, things have turned out differently. Most of the firms in the case are using their in-house applications for message generation, and they always use FrontEnd to check the status of their outgoing messages (i.e. to check whether those messages have reached PortIC and the final addressee), for the reception of messages (even though those messages are automatically integrated with internal systems), and for printing purposes (i.e. when a shipping agent prints a previously sent transport order and gives the paper document to the hauler). There are two reasons for this use, which was not foreseen by FrontEnd's designers. First, most of the users feel more confident doing a double check on incoming messages: FrontEnd on one side and their in-house application on the other. They look at FrontEnd and when there is a new event –i.e. new message- they enter their in-house application to check the changes. Second, systems developers of these companies do not want to do extra work by integrating all incoming messages, given that they consider some messages are of no value to their companies and their managers have not demanded them to integrate those messages into their firms' systems. They consider the cost of manually processing these incoming messages by the end users is much less than the effort of integrating them into their systems.

4. Unintended consequence. The increasing use of FrontEnd progressively worsened its performance, which has resulted in users complaining about the service.

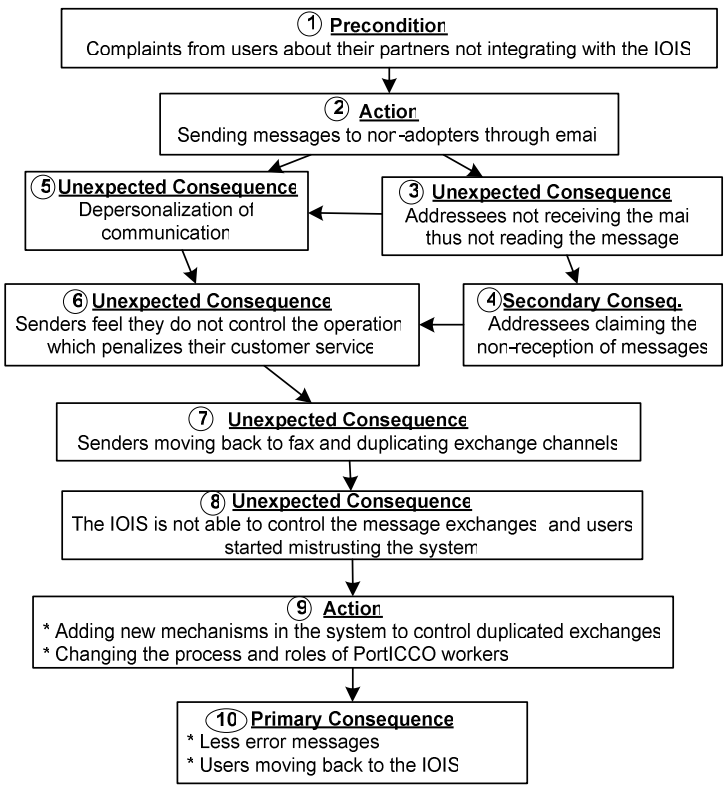
5. Action. Consequently, PortIC managers first increased the processing capacity of the system. Secondly, they considered to redesign the logic of FrontEnd in order for users to easily and rapidly view messages. An analyst of PortIC noted:

> "The initial aim [for FrontEnd] was not that the tool be used to check whether or not a message has arrived. As the number of users increases the tool becomes more sluggish. Because every time you start the application or refresh the list of messages that's a query to the database. We have a new tool in mind. It is a web-based tool where the user would see the essential data of a message: reference number, sender, receiver, date of dispatch, etc, and could click a specific message and visualize it in PDF".

6. Primary consequence. The first results from resizing the hardware have been: better response times of the FrontEnd, and a perception by users and developers alike that the system is more stable than hitherto.

5.3 Strategy 3: Managing the coexistence of multiple exchange channels

1. Precondition. The initial adopters complained to PortICCO because only few of their partners, which in some cases represented less than 5% of their exchanges, were integrated with PortIC. This meant that those adopters had to maintain several systems (PortIC, fax, other EDI, etc.) to interact with partners.



2. Action. As a result of this request, TelFor members decided to add a new qualifier to the FTX (free text) segment of the EDIFACT messages for the e-mail address of the addressee. This allowed PortIC adopters to send messages the same way regardless of the addressee's identity. They did not have to

check if the addressee had adopted PortIC. PortIC would do that job. In the event that the addressee was a non-adopter, the system would forward a message to the e-mail address instead. Most of the non-adopters gave the e-mail of the sales manager or the IS manager for contact purposes but not of the person in charge of message processing (usually a clerk in the import, export or transport departments).

3. Unexpected Consequence. First, the result was that the marketing and IS managers usually did not forward the message to the right person inside their companies, did not read it or deleted it by mistake.

4. Secondary Consequence. Later on, the clerks (addressees), who should have received the message, called the sender to chase things up.

5. Unexpected Consequence. On the other hand, as messages were not directly received by the right person (the clerk who had to process it), senders felt that the communication had become depersonalized.

6. Unexpected Consequence. Senders felt uncertain about the communication status; in addition they considered they had less control over the business operations, which, in turn, had a negative impact on the service they provided to customers.

7. Unexpected Consequence. These two consequences led to senders mistrusting the PortIC system and moving back to prior systems (i.e. fax) when they had to interact with non-adopters of PortIC. The result was that sometimes users sent messages through several channels, first via PortIC and later when there was a problem they resent the message via fax. Thus the entire workflow was partially fulfilled through PortIC and partially through other channels (fax, e-mail, phone or paper-based).

8. Unexpected Consequence. A set of problems was reported as a result of this duplication of messages. For instance, some shipping agents complained to PortIC because they sometimes received duplicate ‘gate-out notification’ messages from depots –messages with the same ‘release order’ number. After some analysis at PortIC, they discovered that the reason was that haulers, in order to make their work easier and faster, made photocopies of former ‘release-order’ messages and gave them to depots. Later the depot in order to submit the ‘gate-out notification’ used the ‘release-order’ number that the hauler had used.

> "after all, haulers have to pick up a TEU (twenty feet equivalent unit) from a depot, and it is easier for them to take any release order, make a photocopy and go quickly for that container than to look for the right release order." (analyst of PortIC justifies this practice)

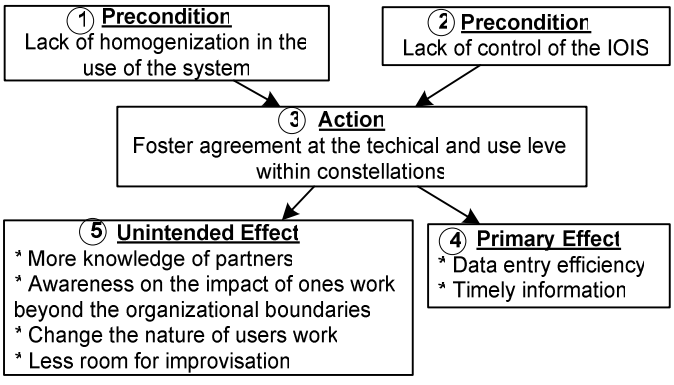
As PortIC had no proof of haulers having sent the message by paper, PortIC could not coordinate and synchronize the flow of exchanges. PortIC was not able to track the status of document exchanges, which sometimes generated error messages to the parties who then got confused, thus making PortIC's adopters even more distrustful.

9. Action. PortIC managers responded by introducing two measures. First, they added automatic mechanisms in the application to control inconsistencies over flow of messages. Second, they defined new working procedures and new roles within PortICCO to ensure that any company, who was not integrated with PortIC but wanted to receive messages by e-mail, had internally organized their procedures so that the right addressee (clerk) was the one receiving the message. This new role at PortICCO monitored those new adopters till there were no errors in the exchanges.

10. Primary Consequence. The result has been a decrease in the number of error messages generated by PortIC as a result of inconsistent exchanges, and a move back to PortIC by some users to send their messages.

5.4 Strategy 4: Agreeing on the operational use of the system

1 and 2. Preconditions. The way companies use PortIC depends not only on how they integrate with PortIC but also on how their partners integrate and use PortIC. For instance, users are accustomed to their way of filling out messages; sometimes this means that they do not use all the fields or combine different fields in one. When fax is used, the addressees of the message retype the message in their systems. In doing this task they interpret the content of the message and if there is a mistake they correct it or call the sender. The fact that incoming messages are automatically integrated with internal systems, means that messages are syntactically correct, however, data may be located in other fields, rendering the message



semantically incorrect. The IOIS (PortIC) has no way of detecting these inconsistencies (assuming the messages follow the standard syntax). Therefore, the way a sender (human or system) generates a message may hinder the receiving company from automatically integrating that message into his in-house systems.

> "The problems appear when we have to integrate incoming messages automatically with our systems. For instance, if a shipping agent [the sender] types the address and city where we have to pick up a container, in the address field of the EDI message, instead of typing the city in the city field, or if he types a wrong postal code…[then] our system will not be able to compute the costs of a service automatically, and the message will require manual checking." (manager of a hauler)

On the other hand, as we have seen in strategy 3, when all the messages do not pass through the IOIS, for instance, because a user decides unilaterally to send a message by fax, then it is impossible for the IOIS to control and monitor the message exchanges. The IOIS may even generate error messages because the workflow is incomplete.

3. Action. These two anomalies in the functioning could be largely solved if the different users (that belong to different companies) agreed on the way they fill and the channels they use to exchange messages. To overcome these situations, PortICCO created groups of firms of different type (i.e. inland terminal, shipping agent, and hauler). PortICCO held meetings with these firms in order to standardize the message exchange within the group. Firstly, they agreed on the filling of messages,

> "The worker at the shipping agent who completed the message one way, changed to a more structured approach. It was the same story at our end." (manager of a hauler)

Secondly, they synchronized the frequency of exchanges between their systems,

> "the inland terminal did an ftp to gather the messages every five minutes, we did it every three… Finally we adjusted these times in order to ensure the messages could not arrive after the physical service was carried out." (manager of a hauler)

4. Primary consequence. This agreement at the level of use within the group of firms has helped reduce the number of data entry errors, and led to a greater perception that information is received on-time.

5. Unintended consequence. On the other hand, this action has caused unintended consequences: Firstly, end users have more and better knowledge about the work of their partners, as well as about the impact of their actions on their partners. Secondly, the integration with new partners is now easier,

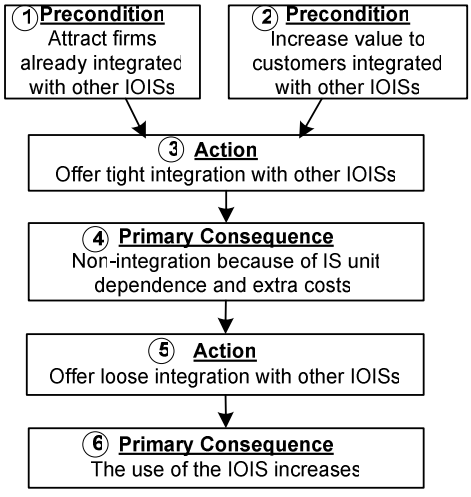
because after each agreement, developers get some knowledge that will prove in further integration projects.

> "As a result of these meetings we have seen progress. In addition, it is now easy for us to integrate with a new shipping agent. Drawing on earlier experience, it now takes three or four days to do what took six months with the first shipping agent." (manager of a hauler)

Thirdly, when fax was the normal exchange mechanism, addressees had to retype messages; during the retyping they interpreted the content of the messages and if there was a mistake they corrected it. Once an incoming message is integrated with the internal systems, workers do not have to retype it but check whether it is semantically correct. Therefore, the nature of work has changed, from data entry to message checking on the screen. Some of the companies in this study have had to train their employees into the new way of working.

Finally, when systems were not integrated the whole system was more flexible. For instance, if there was a last minute change of truck driver, the hauler or the truck driver could change the field covering the driver's ID shown on the paper-based document. However, now that the message is sent in advance through PortIC, a new truck driver runs into problems at the terminal gate if a new message changing the named driver has not been sent. Moreover, this message is sent by the hauler not the driver. Therefore, as the whole system is more integrated, there is less room for improvisation and last minute changes.

5.5 Strategy 5: Balancing the degree of integration



1 and 2. Preconditions. PortIC aims to be a solution for a context with clear boundaries: the inland transport of goods in the Seaport of Barcelona. PortIC managers, however, wanted to increase the value to existing customers as well as attract new ones, who were users of other IOIS.

3. Action. Accordingly, in 2004, PortIC management suggested to some of the multinational firms operating in the seaport that PortIC would integrate with their preferred IOIS. For instance, they first approached a shipping agent (ShAg1). ShAg1 mainly uses two

information systems: a local system and the corporate system, which is hosted at the headquarters of the sea carrier in China. Every ten minutes, ShAg1 downloads information from the corporate system, and once a day ShAg1 uses ftp to upload some other information to the corporate system. However, the headquarters do not permit the ShAg1 to upload messages to the corporate system automatically. As a result, clerks of ShAg1 have to log into the sea carrier's corporate system and manually enter those messages that have to be processed in real-time at company headquarters (the case of bookings and shipping instructions). On the other hand, ShAg1 has an interface between its local system, an IBM AS/400, and PortIC. Some of the incoming messages from PortIC are automatically processed and integrated into the local system, while others (bookings and shipping instructions) are printed and re-typed into the corporate system.

4. Primary Consequence. By mid 2004, as the sea carrier was integrated with CargoSmart (an IOIS for the ocean container transportation industry), ShAg1 and PortICCO agreed that PortIC could forward any booking or shipping instruction message to CargoSmart, which in turn will submit those messages to the corporate system of the sea carrier. That way ShAg1's clerks would avoid re-typing those messages in the corporate system. At the end of 2004, PortICCO started sending test messages to the IS unit at the headquarters of the sea carrier in order to test if the structure and content of messages fitted. However, PortICCO never received any answer. Later the IS manager of ShAg1 recognized,

> "We understand that our headquarters [the sea carrier] are not interested in receiving these messages through CargoSmart, because there is a cost for the sea carrier. In the beginning we did not understand why the headquarters was not positive about that. But finally we understood that it was because of the extra costs. [the sea carrier would have to pay CargoSmart to receive those messages through CargoSmart. By contrast, retyping of messages by ShAg1 in Barcelona did not represent any extra cost for the sea carrier.]"

On the other hand, the two biggest freight forwarders in the study refused to integrate their systems with PortIC. These companies have a centrally managed IS organization for the sake of ICT and business process standardization. This unit manages the corporate system as well as the integration of this corporate system with other IOISs (i.e. GT Nexus and Inttra) or preferred customers' corporate system. This central unit, however, was not based in the port of Barcelona. On the other hand, the IS

local unit of these organizations is intended to provide only support, for instance, in terms of ICT maintenance and user training. Any extra local requirements dealing with business process, message format or ICT architecture, have to be submitted to the central IS unit and (assuming it is approved) take months to implement. Accordingly, local offices opted not to ask their central IS units to adapt their systems to the local requirements (i.e. integrate with PortIC). They use fax or e-mail to fulfill these requirements instead.

5. Action. In February 2005, PortICCO management, given the non-integration of multinationals with PortIC, signed a deal with Inttra (an IOIS for global shipping) in order to integrate both systems. Unlike with CargoSmart where PortIC customers were forced to tightly integrate their systems with PortIC, in the case of Inttra, PortIC customers could get data from Inttra via PortIC through a website or e-mail (both being loose coupling mechanisms). In January 2006, PortIC integrated with Inttra.

6. Primary Consequence. The result has been that some customers of PortIC are making more use of the system to access information from Inttra.

6 Action as Mutual Adaptation

The five strategies presented above modify existing (pre)conditions or the consequences of other actions to align the IOIS with its users' environment. IOIS management acted as agent of change (Markus and Benjamin 1997) in order to increase the extent of use of the IOIS. This is in line with the mutual adaptation perspective (Leonard-Barton 1988). As Leonard-Barton (1988) argues, "implementation is a dynamic process of mutual adaptation between the technology and its [user] environment" (p. 252). Adaptation is the result of misalignments between what the technology does and the current and desired future state of the receiving organization (Leonard-Barton 1988). Misalignments can be categorized as (Leonard-Barton 1988, p.255): 1) Technical: "the technology with its original specifications or with the production process into which it is introduced"; 2) Delivery system: "the technology with the user organization infrastructure (supporting hardware, software or educational programs)"; 3) Value: "the technology with job performance criteria in the user organization".

Table 1 shows for each of the five strategies some misalignments that triggered managerial action (response) in order to adjust them. Because of the focus of the paper (the actions carried out by the IOIS management), we focus on the adaptations from the IOIS perspective. Likewise, there are other relevant activities (i.e. user training and support), that are not explicitly represented in any of the strategies but cross all of them. These activities aim to support the actions performed by managers and thus address primarily misalignments between the IOIS and adopters' business processes and skills (delivery system).

Finally, the case shows the evolutionary nature of the IOIS implementation (Ciborra 2000). Adaptive actions arise from the problems and decisions that managers deal with on a daily basis. Although managers may formally articulate strategies on a periodic basis (formally planned strategy), enhancing the use of the IOIS lies in the ability to understand the dynamics of multiple users and to adapt programs of action in response to those dynamics.

Strategy	Types of misalignments	Responses/Adjustments of misalignment
Keeping the autonomy of adopters	Technical misalignments: companies wanted to keep their business processes thus adapting them to the standard and the new system specifications seemed unnecessary (box 1 and 2); in addition there existed a gap between the standard specifications and the current business processes of the companies (box 2). On the other hand, the initial design logic of the IOIS constrained the use of the system (delivery system misalignment in box 6).	The messages and data flows defined in the standard as well as the applications and procedures of the IOIS were adjusted.
Accommodating the IOIS to unintended uses	Delivery system misalignments: the web-based application loaded all the fields of a message, when users were only interested in a few of them. That damaged the performance of the IOIS, which in turn penalized the productivity of users in the workplace (value misalignment in box 4). In addition, the architecture of the IOIS had been designed to support a fewer number of transactions (technical misalignment of the IOIS with its original specification).	Misalignments were addressed with changes in the hardware architecture and application's logic of the IOIS.
Managing the coexistence of multiple exchange channels	The submission of e-mails to non-adopters created delivery system misalignments to the addressees (boxes 3 and 5), which in turn penalized senders work. Some of the messages were lost, and this damaged the senders' service to the final customers (value misalignment in box 6). Then senders started duplicating exchange channels, which in turn caused lack of coordination in the message exchanges (delivery system misalignment in box 8).	Misalignments were addressed with changes to applications of the IOIS and with changes in the working procedures of clerks at the IOIS.
Agreeing on the operational use of the system	There were delivery system misalignments as the lack of homogenization in the use of the system created difficulties to addressee firms when integrating incoming messages (boxes 1 and 2).	Misalignments were addressed by adjusting user's exchange systems, working procedures and awareness of the impact of their actions.
Balancing the degree of integration	Firm's headquarters did not feel it worth integrating their corporate systems with local initiatives such as PortIC because they aim to homogenize their business processes and technologies throughout the company not only locally (technical and delivery system misalignment).	Adjustments were made to the applications and procedures of the IOIS in order to avoid companies to tightly integrate their systems with the IOIS. They provided loose couplings mechanisms.

Table 2: Strategies, misalignments and adjustments

7 Contributions

We consider this paper contributes to IOIS management. First, the paper shows that given the role of unintended uses and change, IOIS implementation requires management to: 1) devote resources not only to design, but also to understand the misalignments that arise during use between the IOIS and its adopters at three dimensions: technology, delivery system and value; and 2) respond in order to forestall these misalignments. Secondly, we have presented a set of strategies (managerial manoeuvres), which were triggered by misfits between the IOIS and its adopters, that have proved successful in promoting the integration and use of an industry IOIS. Those strategies, which are grounded on an in-depth case, may provide a meaningful guide to action for IOIS management.

On the other hand, this paper also contributes to IOIS research. First, IOIS literature has proposed primarily factor-based models to explain either the adoption decision or study the extent to which the IOIS is used. This paper is novel in the sense that it presents a process-oriented description (in terms of sequences of actions) of IOIS integration and use. Secondly, we use grounded theory, which to our extent has not already been used in the process-oriented IOIS literature. Thirdly, the paper illustrates the use action-oriented diagrams; we consider such diagrams are useful graphical tools that help structure and report on processual data, which constitutes an important task during theory modelling. Finally, although this is a single case, and thus generalizability cannot be assessed, its strength lies in the depth and length of data gathering.

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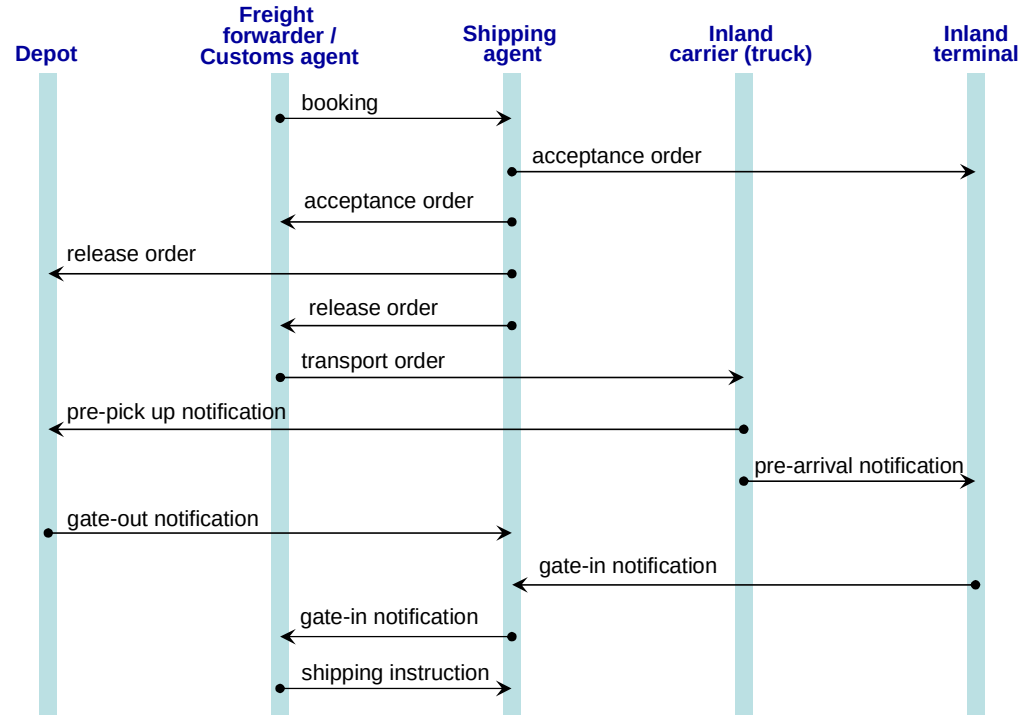
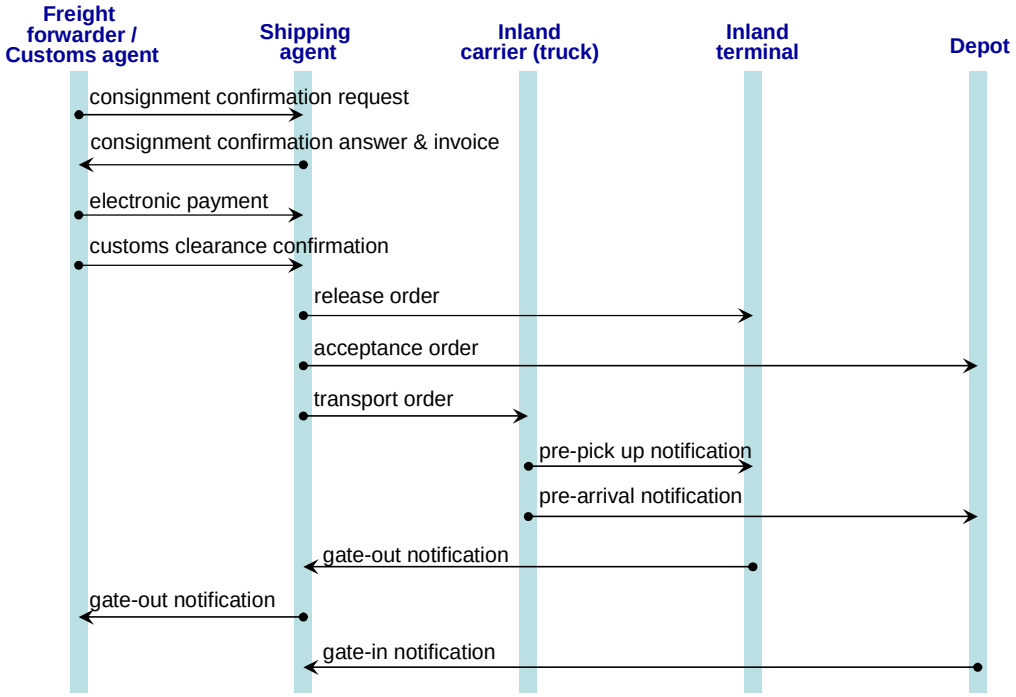
Appendix A: Scenarios for private-to-private exchanges



Messages for the export scenario (private-to-private exchanges)



Messages for the import scenario (private-to-private exchanges)