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Exploring the Intricacies of Integrating with a Port Community System

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Abstract

On the basis of an exploratory case study, this paper is intended to provide understanding on the intricacies associated with the integration of firms with a business sector information infrastructure (BSII) such as a port community system (PCS). Although there is some research on the implementation of PCS, these studies have rarely addressed the issue of integration of preexisting systems. We address this gap with a case study of a PCS in a Spanish port community, which, moreover, complements prior studies by adopting a processual socio-technical perspective on integration. Finally we elaborate implications relevant to the implementation of BSIIs.

Keywords: *information infrastructures, industry standards, B2B integration, port industry, case study*

1. Introduction

A Port Community System (PCS) is an electronic platform that connects the multiple systems operated by a variety of organizations that make up a seaport community. Based on this definition a PCS qualifies as a BSII (Hanseth et al. 2004). Accordingly, a PCS is a shared, evolving and heterogeneous installed base of ICT capabilities based on standardized interfaces (Hanseth et al. 2004). It is shared in the sense that it is set up, organized and used by firms in the same sector, in this case a port community. A PCS evolves as new companies integrate with it or as new types of exchanges become possible through the PCS. A PCS is heterogeneous in the sense that it links multiple types of technologies, processes, people and standards. Finally a PCS is not designed from scratch; the preexisting systems (installed base) will influence the paths that the implementation of the PCS takes.

There is only a handful of essays in the IS field that have studied port community systems (Applegate et al. 2001; Hock-Hai et al. 1997; King et al. 1990; Mcafee et al. 2003; van Baalen et al. 2000). Most of these studies, however, are descriptive by nature and do not tackle the integration of preexisting systems. This paper complements prior literature by exploring how the integration of a group of firms with a PCS unfolds. We focus on systems integration at two levels: interface and network. We present a case study that revolves around the implementation of a PCS and the integration of several organizations aiming to automate their document exchanges.

The structure of the paper is as follows. First section presents a review on integration and adaptation. Next the research site and method are presented. Next we present the case background. We then analyze the issues that have arisen and how firms have faced them. Finally, we discuss the implications for research and practice.

2. Integration, Adaptation and Standardization

A PCS intertwines the activities of the firms operating in the port community and therefore, embeds the business logic of the community. The promise of a PCS is to bring about integration, which will give community members access to pertinent data and will enhance the efficiency and effectiveness of their interactions. This promise, however, depends on the way the various heterogeneous systems get integrated. Literature on systems integration differentiates two types of integration: internal (integration among internal systems in an organization) and external (integration between systems external to an organization with the internal systems of the organization) (Markus 2000). As the object of study is the integration of preexisting systems with a PCS we focus on external integration. In addition, for the purpose of the paper we split external integration into: interface and network integration.

Interface integration refers to "the process during which a firm alters its business practices and applications so that they interface with its EDI applications" (Iacovou et al. 1995:468). This definition shows that, during the integration of the different systems, adaptation is necessary due to misfits between different elements or domains (technical, organizational, behavioral, etc). Adaptation refers to the mutual adjustments among the technology, organizational structures, work processes, skills, and work climate of the multiple firms. Adaptation encompasses the reinvention of the technology to conform to the work environment and the simultaneous adaptation of the organizations to use the new system (Leonard-Barton 1988). Integration requires that adaptation produces a stable relationship between the ICT artifact, the people, the process, the organizational structure, etc. Thus to study the integration of preexisting systems with a PCS we focus on the actions taken by the diverse actors to appropriate the ICT features, modify their working procedures, their organizational structures or their communication patterns. This paper tackles two types of adaptation: technical and organizational (Leonard-Barton 1988; van Baalen et al. 2000). Technical adaptation includes the modifications to existing hardware, telecommunications, software and data models to integrate with the PCS. Organizational adaptation includes the changes in workers' roles and responsibilities, necessary skills, experience and knowledge, as well as the changes operational processes and structures as a result of integrating with the PCS.

Network integration refers to the process during which a group of firms agree on the way they are going to interact electronically and to connect their systems. This process entails the development of standards for electronic interaction (B2B standards) (Wigand et al. 2005) and the further development of technological infrastructures that support those standards (either customized one-to-one links or BSIIs, being the latter the object of this paper). B2B standards are usually concerned more with the use of IT and with the semantics of information and business processes, than with IT (Markus et al. 2003).

According to Reimers (2001), B2B standards are defined at three levels: syntactic, semantic and pragmatic. The syntax level concerns the structure and content of messages. The semantic level concerns the meaning of messages and processes. Finally, the pragmatic level concerns the purpose of messages being exchanged between the companies. Network integration (standardization) is also a political and negotiating process, where there are complex interactions between vested stakeholders (Pouloudi et al. 1997).

Finally, organizational theorists argue that tight coupling systems (highly integrated systems) constraint the capability of a firm to assimilate and accomplish change (Orton et al. 1990). Perrow (1999) adds that tight coupling systems are more prone to system failures or unanticipated outcomes. In line with this argument, by regarding integration as non-deterministic process we consider that integration may often take unpredictable paths that give rise to unexpected effects (Hanseth et al. 2004).

3:   Research Method

The study was conducted in a Spanish port community. Since our emphasis is on understanding reality in a specific context, we opt for using an interpretive case study (Walsham 1995). The empirical work was carried out over a 9-month period (March 2005 -November 2005). Data collection consisted of semi-structured interviews, document analysis, site visits, and meeting attendance. Over 27 interviews were conducted, each about 1 hour long (Table 1). Each interview was recorded, transcribed and analyzed. This process proceeded iteratively and guided the following interviews.

Table 1: Summary of the interviews conducted

Type of firms	#Firms	#Interviews	Position
Shipping agent	2	6	CEO, IS manager, Operations manager, IS developer
Freight forwarder	4	6	Maritime manager, IS manager, IS developer
Inland terminal	1	3	CEO, Operations manager, IS developer
Haulage contractor	2	4	CEO, Operations manager, IS developer
Port Authority	1	3	IS manager, Analyst, IS developer
ePortSys	1	5	CEO, IS manager, Analyst, IS developer

4.   Case Background

ePortSys, a pseudonym, is a PCS that was launched in mid-1999 in a Spanish seaport in order to coordinate the activity of firms in the port's landside transport network (which encompasses the transport of containers between the port and a place in the hinterland, and vice versa) and to integrate all the information being exchanged between the various port agents (Figure 1). In the envisioned scenario, ePortSys would: (1) implement the

standard previously defined by StandCom[1], a standards committee; (2) capture the information produced in any exchange within the community, thus avoid the need to retype data, substituting paper, and reducing the errors and processing costs; (3) centralize all community information; and (4) provide transparency and real-time information to facilitate the track & trace of goods and reveal inefficiencies.
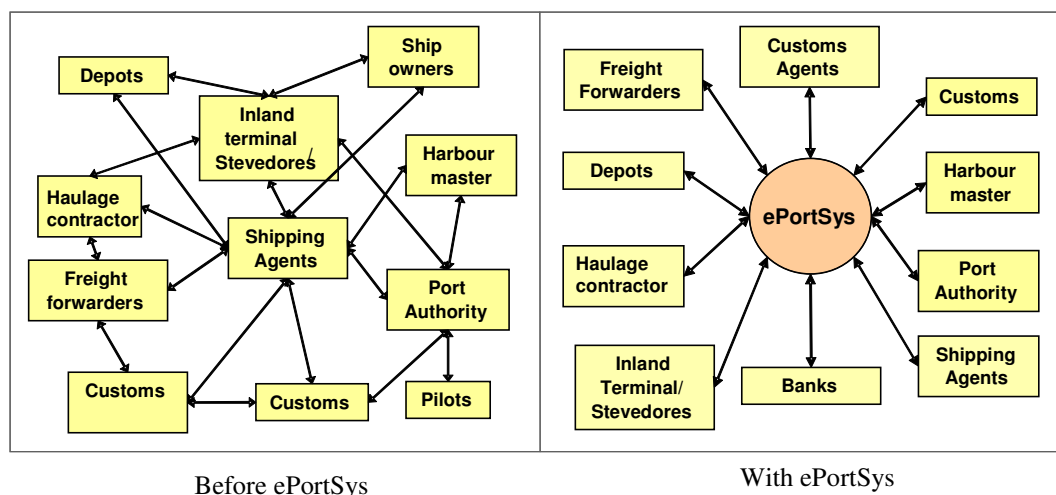

Figure 1: Envisioned scenario with ePortSys (arrows represent information flows)

ePortSys 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, customs agents, shipping agents and Chamber of Commerce). These same industry stakeholders set up a company (ePortCo) in 1999 to manage the operation of ePortSys. ePortCo offered the following services:

· Private-to-public exchanges: exchanges between a private organization and a public body (i.e. cargo manifests, dangerous cargo declaration, customs request, customs responses, etc).

· Private-to-private exchanges: exchanges between private organizations

· Real-time information services via a browser that allow the documentary track & trace of containerized goods.

In line with the idea of openness to the whole community, ePortSys was based on an Internet-based technological infrastructure in order to give everyone access, regardless of the system they had in place (Figure 2). Companies could send and receive messages in the formats defined by StandCom (EDIFACT, XML, and flat file) by using various services (ftp, oftp, email). For those who did not wish to integrate the messages with their in-house applications, ePortSys developed a standalone Java-based application (FrontEnd) that ran on a PC and that could be used for the generation and reception of messages.

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1 Since 1993 a committee, constituted by some members of the port community, had worked on the definition of a standard for the processes and messages exchanged in the port community.
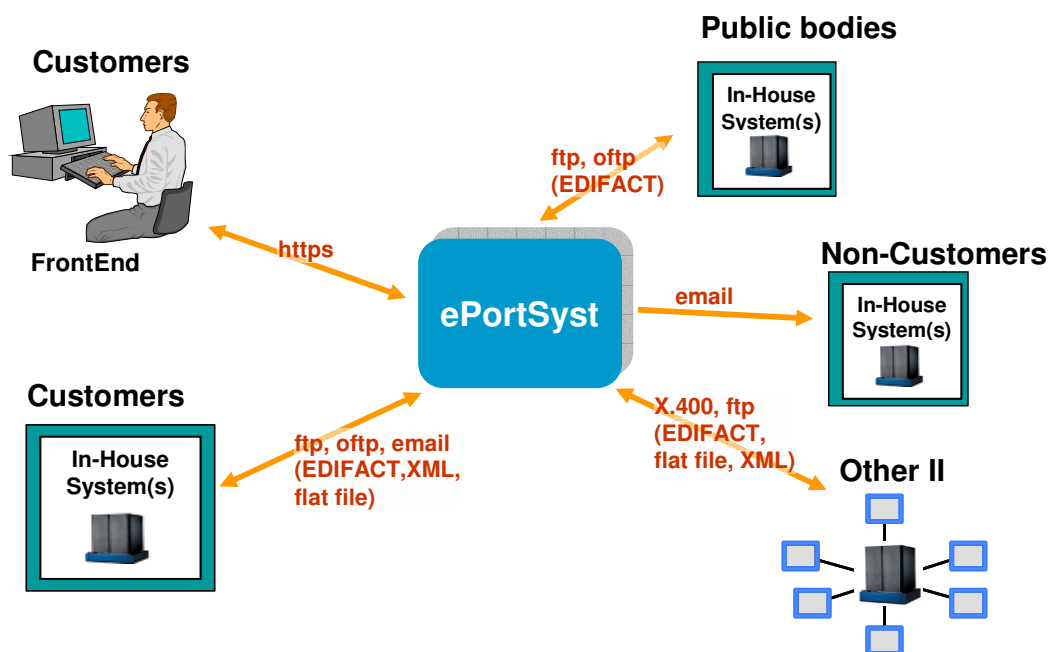
Figure 2: General architecture

By mid 2001, ePortSys was close to collapse. The number of firms using ePortSys for private-to-public exchanges was acceptable, but the ratio of use of ePortSys for private-to-private exchanges was far from satisfactory. The data exchange scenarios initially designed by StandCom and later implemented by ePortSys for private-to-private exchanges inscribed certain working practices that did not fit with adopters' processes. Firms refused the programs of action inscribed in ePortSys and moved back to earlier exchange systems and procedures.

Then StandCom members realized the standard needed to translate the interests of port community members if ePortSys was to be fully adopted. Until then, StandCom had been working with one main group, which was involved in all the standardization activities. The scope was too broad. It was therefore decided to set up a steering committee and several tasks forces, which would each work on different parts of the standard (

Figure 3). All the actors, regardless of their size, that were interested in the standard were invited to participate in the process. As one shipping agent put it,

> "The success of such an standardization process requires the involvement of small companies. We must never forget them. We cannot design solutions for those of us who move millions of TEUs (twenty feet equivalent unit) if these solutions are not feasible for the small shipping agents or freight forwarders. Because in our port, the combination of those small actors is significant"

He added,

> "…the involvement of small and medium companies in the gestation of things, makes them believe in those things. It is easier to give them room from the beginning than having to persuade them afterwards in order to integrate in something which is already built."

Moreover, some private participants in StandCom promoted the creation of a Spanish standardization committee (Process Harmonization Group) to extend StandCom's work to other ports in Spain.
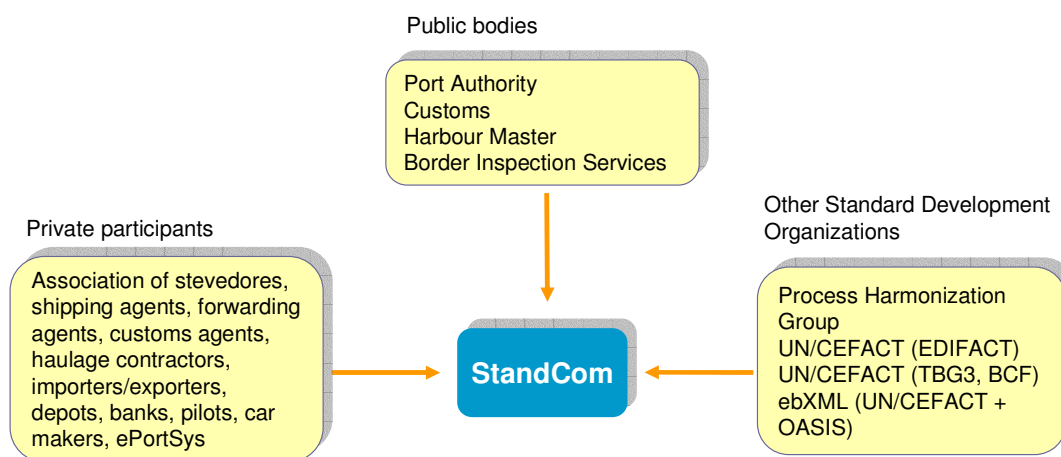
Public bodies

Port Authority
Customs
Harbour Master
Border Inspection Services

Private participants

Association of stevedores,
shipping agents, forwarding
agents, customs agents,
haulage contractors,
importers/exporters,
depots, banks, pilots, car
makers, ePortSys

Other Standard Development
Organizations

Process Harmonization
Group
UN/CEFACT (EDIFACT)
UN/CEFACT (TBG3, BCF)
ebXML (UN/CEFACT +
OASIS)

StandCom

Figure 3: StandCom stakeholders after 2001

Between 2000 and 2004, the number of participants at StandCom rose from under 20 to over 130. Seventeen working groups were created, and on average seven were working at any one time. By the end 2003 StandCom had finally redesigned the messages for the export and import scenarios (Appendix A), which covered private-to-private exchanges. By then StandCom had turn into an active, legitimate actor whose work was accepted by all the stakeholders.

5. Analysis

The number of firms integrating with ePortSys has risen substantially since early 2002. The integration process, however, has not been exempted from surprises, requiring some adaptations from various actors. Next we analyze how the integration unfolded during this 4-year period (2002-2005). The analysis is split into sections, each one presenting a given issue actors faced in integrating with ePortSys.

5.1 Retaining Autonomy

There was a common belief among ePortSys promoters that firms would introduce organizational changes to take advantage of ePortSys. Accordingly, ePortSys was designed to allow adopters to make changes in their working processes. As the CEO of the Port Authority observed,

> "[ePortSys] is a system that is easy for companies to use. But this does not prevent the fear of the unknown from existing, represented by an internal change and a change in the way of thinking about the activity that we carry out each day".

However, most of the firms in the study merely saw ePortSys as a glorified postman, receiving messages and forwarding them on to the right place. From the outset, the organizations in the study did not introduce changes in their organizational structures, and avoided making changes in their internal processes. They saw ePortSys as a tool that simply replaced the fax or former EDI systems they had in place.

6

This could be partially explained as ePortSys embeds the messages and information flows defined by StandCom, but it does not embed any internal procedures for the companies, nor does it guide the integration project for adopters. Thus companies can follow different paths for integrating in ePortSys.

Likewise, companies avoided making changes to their databases. Interoperability was 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. [ePortSys], however, uses the Lloyds number. In the case of 'acceptance order' I receive the Lloyds number from [ePortSys]. 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."

Very often ePortSys has made changes to enable firms to retain their autonomy. For instance, in the case of exports, StandCom agreed that drivers would not need to show any paper-based documentation to enter the inland terminal providing that the haulage contractor had previously specified the driver in electronically submitted 'pre-arrival notification'. However, once ePortSys had implemented the procedure, inland terminals objected to it arguing they had never worked that way. Then ePortSys introduced some measures to persuade inland terminals. A manager at ePortSys who participates in the StandCom explained,

> "There was an 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 haulage contractors could submit the 'pre-arrival notification' and that ePortSys 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."

5.2   Linking with Other BSIIs

ePortSys aims to be a solution for a context with clear boundaries –i.e. the inland transport of goods in a specific port. However, for multinational freight forwarders or sea carriers this context represents a small piece of their supply chains. Since the dawn of the Internet, these organizations have jointly developed BSIIs –i.e. Inttra, GTNexus, CargoSmart- to standardize their worldwide communications with their partners. They do not envisage integration with solutions like ePortSys, which serve local needs and do not always fit with their processing, data and technological standards. As a shipping agent stated:

> "Künhe Nagel told us that [ePortSys] was a nice tool but they were creating a worldwide e-commerce platform with other sea carriers and freight forwarders. They said: 'it is a good idea to have a tool such as [ePortSys] in this port. But we want to interact with your company the same way we do in Shanghai'."

The two biggest freight forwarders in the study refused to integrate their systems with ePortSys. These two companies have a centrally managed IS organization for the sake of technological and process standardization. This unit designs and manages the corporate technological infrastructure as well as the integration of this corporate infrastructure with other BSIIs or preferred customers' corporate infrastructures. This central unit, however, was not based in the studied port. In addition, 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 requirement –that deals with process, message format, technological architecture- has to be accepted and developed by the central unit. Even the simplest requirements have to be submitted to the IS unit and (always assuming they are 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. StandCom's standard). They use fax or e-mail to fulfill these requirements instead.

In order to foster the integration of these companies with ePortSys, ePortCo suggested to some companies that ePortSys would integrate with their preferred BSII. This suggestion was first made to 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. 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 headquarters. However, the sea carrier does not allow ShAg1 to upload messages to their corporate system automatically. As a result, workers at 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 HQ (which is the case with bookings and shipping instructions). On the other hand, ShAg1 interfaced its local system, an IBM AS/400, with ePortSys. Some of the incoming messages are automatically processed and integrated into the local system, while others –bookings and shipping instructions- are printed and re-typed into the corporate system.

By mid 2004, as the sea carrier was integrated with CargoSmart, ShAg1 and ePortCo agreed that ePortSys could forward any booking or shipping instruction message to CargoSmart. That way ShAg1 would avoid re-typing those messages in the corporate system, and the sea carrier would be integrated with ePortSys. At the end of 2004, ePortCo 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. But ePortCo never received any answer. Later the shipping agent confessed:

> "We understand that our headquarters 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."

5.3   Limits of the Standard

Participants at StandCom negotiate the meanings for messages and message flows (semantic level), as well as the structure and format of messages (syntax level). However, they do not design a complete communication scenario (pragmatic level) –such as that defined in (Kimbrough et al. 1997)-. For instance, the standard does not specify actions for receivers, such as acknowledging the reception or the processing.

As a response to this limitation, ePortSys' designers developed a web service that controlled the receptions of messages, acknowledged the issuer of the message and did a syntactical check of messages. This web service runs on the issuers and recipients' systems. The issuer, however, wanted to be notified not only that his outgoing message had been received by the addressee's systems but also that it had been accepted (or rejected due to semantic errors encountered during its processing). This could be fulfilled if each company implemented a processing acknowledgement.

However, none of the companies in the study has implemented processing acknowledgement. This failure has created some logistics problems. Sometimes the haulage contractors had problems at the inland terminal gate as the 'acceptance order' previously sent by the shipping agent had been rejected due to processing errors but

without the shipping agent being notified of the problem. These situations mean that haulage contractors still have to bring a stamped paper-based copy of the 'acceptance order'. Moreover, when the electronic 'acceptance order' has been processed with errors, the terminal gate workers have to generate the message from scratch based on the paper copy.

Some of these logistic inefficiencies could be largely solved if recipients were to submit a processing acknowledgement. Designers at ePortCo are aware of this but they cannot force adopters to implement this message. On the other hand, the standard could require this behavior. However, at the moment, standardization participants consider these issues go beyond of the scope of StandCom. First, several members raise objections to some of these measures, making it difficult to reach consensus. Second, some of these issues go beyond the knowledge of participants in StandCom. These issues therefore remain unresolved in order to maintain the project's impetus.

5.4   Aligning the Interests of Constellations

The shipping agents complained to ePortSys because they sometimes received duplicated 'gate-out notification' messages from depots –messages with the same 'release order' number (Appendix A). After some analysis at ePortSys they discovered that the reason was that haulage contractors, in order to make their work easier and faster, made photocopies of former 'release-order' messages and gave them to depots. As an analyst at ePortSys noted:

> "after all, haulage contractors 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."

Then shipping agents asked ePortSys to control that, but ePortSys argued that it could only be done by the same depot. Finally, ePortSys presented the problem and moderated a meeting with depots, haulage contractors and shipping agents –forming a constellation-. A manager at ePortSys noted:

> "If we succeed in getting the depots change their control procedures it will be an improvement, because we will avoid duplicities in the 'gate-out notification' messages."

Tight integration requires agreement between actors at the level of use. The way the issuer types the message data in their in-house system or the way the message is generated by the issuer's in-house systems may constrain the recipient from automatically integrating that incoming message into his in-house systems. As a manager from a haulage contractor observed:

> "The problems appear when we have to integrate incoming messages automatically with our systems. For instance, if a shipping agent [the issuer] 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."

To overcome these situations, ePortCo created "constellations", which generally comprised an inland terminal, a shipping agent, and a haulage contractor. ePortCo held meetings with the "constellations" in order to standardize how the various companies should generate and interpret the messages at the technical level,

> "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." (A manager form a haulage contractor)

and at user level. The same manager added:

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

Some learning occurred as a result of these adaptive changes:

> "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."

5.5   Consequences of Tighter Integration

In the previous section, we saw that manual processing was required to interpret and correct the messages when there was no inter-firm agreement on how the system should be used. On the other hand, there are companies that standardize system use with partners. The firms thus achieve tighter integration, allowing them to re-allocate their staff to more productive tasks. For instance, employees spend less time on data entry, and more time on customer service and checking messages,

> "Workers at the documentation and trade department have realized that now they have to spend more time controlling instead of on entering data. ePortSys allows the data to flow. The data are generated at one end and there is no need to retype them again, but we have to ensure that data are correct, and if they are not, then correct them."

Companies that are tightly integrated with ePortSys hope to abandon backup systems for data exchange in the short term. However, sometimes, firms become more vulnerable to systems failure in other companies. A shipping agent put it thus:

> "There was an upgrade of the interface application between the Port Authority and ePortSys with respect to the dangerous cargo manifest (DCM), and during two days we could not send the DCM through ePortSys…We had to move back to the use of fax which took us several hours and involved costs."

This shows that unintended consequences stem from the interdependencies between different actors.

5.6   Unexpected Uses and Effects

The FrontEnd application was only intended for use by those companies that were unable to develop their applications for electronic exchanges or for those that did not want to integrate their in-house systems with ePortSys. However, things turned out differently. Most of the firms in the case are using their in-house applications for message generation, however, they always use FrontEnd to check the status of their outgoing messages (i.e. to check whether those messages have reach ePortSys and the final receiver), for the reception of messages (even though those messages are automatically integrated with

internal systems), and for printing purposes (when a shipping agent prints a previously sent transport order and gives a paper copy to the haulage contractor).

There seem to be two reasons for this unintended use. First, most of the users feel more confident carrying out a double check on messages: FrontEnd on one side and their in-house application on the other. They first 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 incoming messages, given that they consider these messages are of no value to the company as they have not been demanded by a manager for incorporation into the firm's IT systems. They consider the cost of manually processing these incoming messages by the users is much less than the effort of integrating them into their systems.

In this respect, the interests of users, developers, in-house applications and FrontEnd coincide in establishing what has become a stable network.

On the other hand, the increasing use of FrontEnd progressively worsened its performance, which has resulted in users complaining about the service. ePortSys managers are currently considering the possibility of redesigning FrontEnd. An ePortSys analyst noted:

> "The initial intention [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, issuer, receiver, date of dispatch, etc, and could click a specific message and visualize it in PDF"

As a result of a request from some users of ePortSys, StandCom added a new qualifier in the FTX –free text- segment of the EDIFACT messages for the e-mail address of the receiver. This allowed ePortSys customers to send messages the same way regardless of the receiver's identity. They did not have to check whether the receiver was an ePortSys customer or not. ePortSys would do that job. In the event that the receiver was not a customer, the system forwarded a message to the e-mail address instead. This measure had an unintended consequence. Most of the non-customers gave the e-mail of the sales manager or the IT manager for contact purposes but not of the person in charge of message processing (usually a clerk in the import, export or transport departments). The result was that these receivers –marketing and IT managers- usually did not forward the message to the right person, did not read it or deleted it by mistake. Later on, the real targets of the message called the issuer to chase things up. This led to issuers mistrusting the ePortSys application, moving back to earlier exchange mechanisms when they had to interact with firms outside ePortSys.

6. Implications

From the case we highlight several aspects that may be of use for the research and practice on implementation of BSIIs:

6.1 Interface Integration

From the beginning, designers of ePortSys assumed that firms would make the required technical and organizational adaptations to integrated with the PCS. The reality shows that firms have avoided doing such adaptations. In a first stage firms in the case only did

technical adaptations, basically in the form of conversion tables. In parallel, the PCS was adapted to the specificities of each of its customers aiming to achieve critical mass; sometimes even supporting the standard in a different way depending on the customer. Later, once the PCS proved to work properly, some of the firms started changing internal working practices and humans skills in order to get more out (internal efficiency) of the integration with the PCS.

Second, the fact that ePortSys is a localized solution may hinder the willingness of some actors –multinational freight forwarders or ship carriers- to integration with the PCS. A solution could be to develop gateways (Hanseth et al. 2004) to link ePortSys with other BSIIs with whom these companies are already integrated. This case, however, shows that there are barriers:

1. The extra costs incurred by the sea carrier in the case of CargoSmart.

2. The dependence of the freight forwarder local office on headquarters (as the gateway threatens the stability of the network comprising HQ, local office, and the corporate system).

3. The gateway pushed companies to be more integrated with the PCS; but those companies did not see the need to integrate. Those companies considered that a website (loose coupling mechanism) that discloses the information was sufficient.

6.2   Network Integration

Standards have already been regarded as a constitutive element of BSII implementation (Wigand et al. 2005). We highlight two aspects from the case. First, the progressive involvement of all the stakeholders during the standardization from 2002 has resulted in an accepted industry standard on the one hand, and has legitimated a powerful standard-setting body (StandCom) on the other. Second, StandCom participants initially reached an agreement for a standard at the syntax and semantic levels. Nevertheless, the pragmatic level, which deals with the intentions of humans when communicating with one another (Reimers 2001), was ignored. The pragmatic level was partially designed after the event by constellations of firms (e.g. covering message completion, when to send an acknowledgement of processing, etc). Once these pragmatic aspects work satisfactorily in a constellation, they are then proposed and negotiated at the Standard Committee level, with a view to extending them to the industry level.

From the outset, ePortSys emphasized a community view of the inland transport network, which corresponded to the Port Authority's vision. However, in complex environments it is very difficult to reconcile the divergence of interests among the different stakeholders (Pouloudi et al. 1997). Not everybody will gain from integrating with ePortSys. For instance, we have seen that multinational companies look for 'one size fits all' solutions, seeking synergies and economies of scale at the expense of more local requirements. Therefore, stakeholder analysis and alignment becomes a relevant ongoing activity in the implementation of BSIIs.

6.3   Bootstrapping Constellations: An Incremental Process

In the period -2002 to 2005- ePortCo undertook persuasive actions in order to facilitate integration, which has bootstrapped a self-reinforcing installed base (Hanseth et al. 2004). ePortCo chose smaller networks or constellations and tried to align their interests. These constellations were large enough to achieve results of value to their group participants. Once these constellations became consolidated, new actors enrolled. On the other hand, as firms usually participate in more than one constellation, this alignment process has to

occur more than once. However, successive alignments become easier as actors learn from experience.

6.4   The Degree of Integration and Its Effects

Promoters of the PCS assumed that most companies would integrate their in-house systems with the PCS. This assumption of tightly coupled systems is perfect when things work. However, when things go wrong (e.g. when one company's system fails to work) the rest of the network is rapidly disrupted. For instance, incorrect or delayed information exchanges between the actors may lead to poor decisions or the inability to plan. In such circumstances, partially integrated systems that have fewer time-dependent processes or sequences of variable processes may prove more robust (Perrow 1999). Loosely-coupled (or partially integrated) systems can accommodate shocks, failures, and pressures for change without destabilization (Perrow 1999). This has a managerial implication: any BSII should provide loose-coupling mechanisms to ensure bootstrapping (Hanseth et al. 2004).

In addition, the fact that organizations want to retain their system autonomy, means that in addition to loose-coupling mechanisms, BSIIs must be flexible enough to accommodate unpredictability that may arise from unintended uses and practices by autonomous actors, as well as the ability to evolve to meet unforeseen needs.

We note several limitations of this study. First, it is a small single case study, thus generalizability cannot be assessed. The strength of the study, however, lies in the depth and length of time we spent collecting data. Second, any conclusion from this study will only apply to the port industry in Spain. We expect the integration of preexisting systems that belong to different organizations to become a relevant IS research topic in the years to come. This paper contributes to the literature on BSII implementation by providing a detailed explanation of the intricacies that arise during the integration process.

References

Applegate, L.M., Siong, N.B., Bartlett, N., and Chang-Leow, D., (2001): PSA: The World's Port of Call, Harvard Business School Publishing, Harvard Case: 9-802-003, 1-34.

Hanseth, O., and Lyytinen, K., (2004): Theorizing about the Design of Information Infrastructures: Design Kernel Theories and Principles, Sprouts: Working Papers on Information Environments, Systems and Organizations, Vol. 4, No. Fall 2004, pp. 1-35.

Hock-Hai, T., Bernard, C.Y.T., and Kwok-kee, W., (1997): Organizational Transformation Using Electronic Data Interchange : The Case of TradeNet in Singapore, Journal of Management Information Systems, Vol. 13, No. 4, pp. 27.

Iacovou, C.L., Benbasat, I., and Dexter, A.S., (1995): Electronic data interchange and small organizations: Adoption and impact of technology, MISQ Quarterly, Vol. 19, No. 4, pp. 465-485.

Kimbrough, S.O., and Moore, S.A., (1997): On automated message processing in electronic commerce and work support systems: Speech act theory and expressive fecility, ACM Transactions on Information Systems, Vol. 15, No. 4, pp. 321-367.

King, J.L., and Konsynski, B., (1990): Hong Kong TradeLink: News from the Second City, Harvard Business School Publishing, Harvard Case: 9-191-026, 1-9.

Leonard-Barton, D., (1988): Implementation as mutual adaptation of technology and organization, Research Policy, Vol. 17, No. 5, pp. 251-267.

Markus, M.L., (2000): A Paradigm Shift in E-Business - Systems Integration, Communications of the AIS, Vol. 4, No. 10, pp. 1-45.

Markus, M.L., Steinfield, C., and Wigand, R., (2003):The Evolution of Vertical IS Standards: Electronic Interchange Standards in the US, Proceedings of the Workshop on Standard Making: A Critical Research Frontier for Information Systems, John L. King and Kalle Lyytinen, (eds.), Seattle, WA, December 12-14

Mcafee, A., Ooms-Wall, K., and Al Qasimi, L., (2003): Dubai Ports Authority (A), Harvard Business School Publishing, Case: 9-603-061, 1-19.

Orton, J.D., and Weick, K.E., (1990): Loosely Coupled Systems: A Reconceptualization, Academy of Management Review, Vol. 15, No. 2, pp. 203-223.

Perrow, C., (1999): "Normal Accidents: Living with High-Risk Technologies," Princeton University Press, Princeton, NJ.

Pouloudi, A., and Whitley, E.A., (1997): Stakeholder identification in inter-organizational systems: gaining insights for drug use management systems, European Journal of Information Systems, Vol. 6, No. 1, pp. 1-14.

Reimers, K., (2001): Standardizing the New E-Business Platform: Learning From the EDI Experience, Electronic Markets, Vol. 11, No. 4, pp. 231-237.

van Baalen, P., van Oosterhout, M., Tan, Y.H., and van Heck, E., (2000): "Dynamics in Setting Up an EDI Community," Eburon Publishers, Delft, The Netherlands.

Walsham, G., (1995): Interpretative case studies in IS research: Nature and Method, European Journal of Information Systems, Vol. 4, No. 2, pp. 74-81.

Wigand, R., Markus, M.L., and Steinfield, C., (2005): Preface to the Focus Theme Section: 'Vertical Industry Information Technology Standards and Standardization, Electronic Markets, Vol. 15, No. 4, pp. 285-288.

Appendix A: Scenarios for the Message Exchange
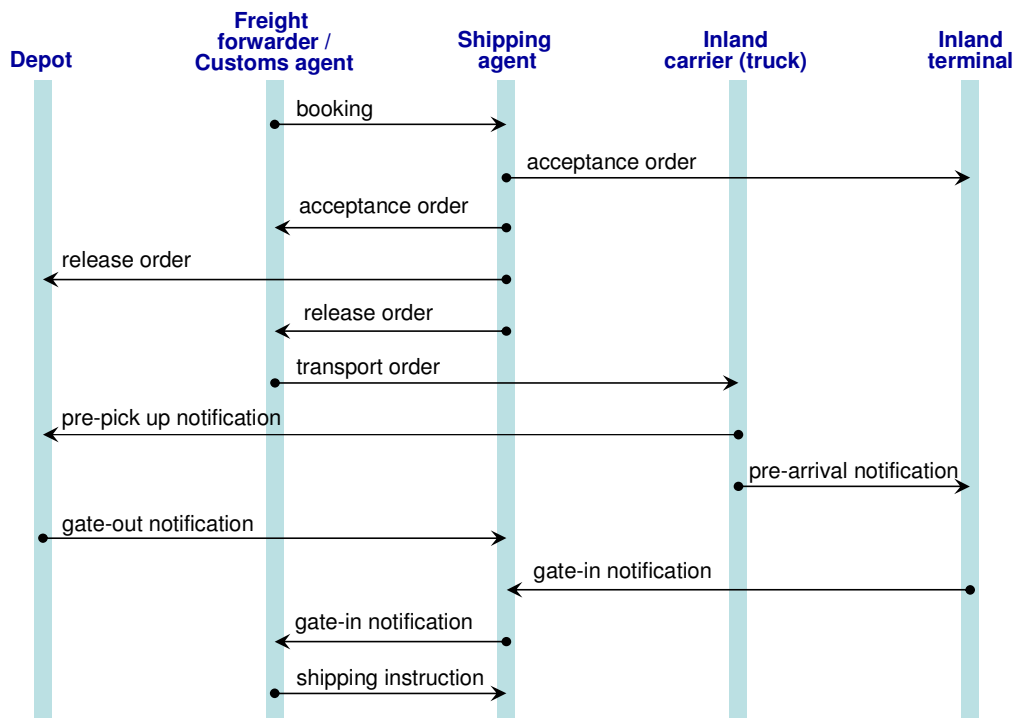
Messages for the export scenario (private-to-private exchanges only)
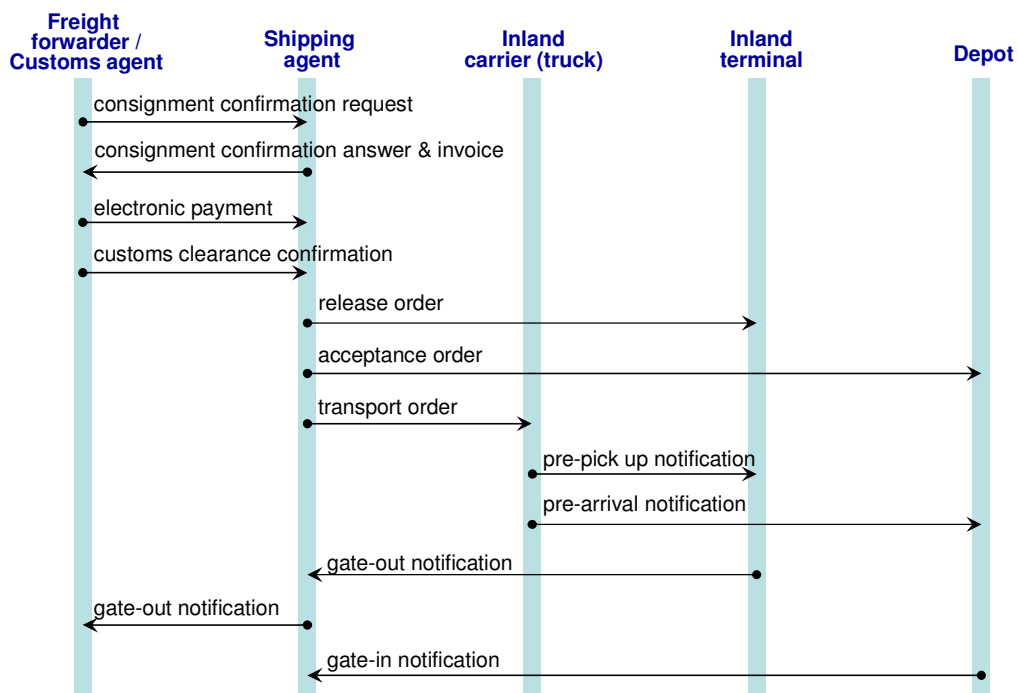
Messages for the import scenario (private-to-private exchanges only)