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E-business enabled operational linkages: The role of RosettaNet in integrating the telecommunications supply chain

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ABSTRACT

A major challenge facing contemporary industrial organization lies in effective supply chain integration. Toward this end, developments in e-business technologies and standards have made the creation of operational linkages—the linking of systems, procedures, and routines of buying and selling organizations—increasingly affordable. In this paper, we evaluate the effectiveness of a particular e-business standard, the RosettaNet, in integrating the telecommunications supply chain with an in-depth dyad-level case study. We find that the RosettaNet standard alone is insufficient for creating interorganizational system-to-system integrations that benefit both transacting parties. We present two propositions for further research on e-business enabled operational linkages.

1. Introduction

A major challenge facing contemporary industrial organization lies in effective *supply chain integration*—the relational and operational coupling of autonomous businesses to cut costs, increase revenues, and improve asset utilization (Stevens, 1989; Bowersox et al., 1999; Lambert and Cooper, 2000; Lee, 2000; Lee and Whang, 2001; Simchi-Levi et al., 2003; Chen and Paulraj, 2004; Christopher, 2005). At the business process level, the question becomes: How to efficiently and effectively couple systems, procedures, and routines of the buying and selling organizations. That is, how to create *operational linkages* (Cannon and Perreault, 1999; Schlueter Langdon, 2006), serving the purposes of both organizations with the least possible expenditures. The managerial challenge of creating operational linkages—where needed—is by no means new, but besides gaining urgency under the last decade, enabling technological solutions are now cheaper and more abundant, following the developments of e-business technologies and standards: Most notably the Internet.

In this paper, we evaluate the effectiveness of the RosettaNet standard in integrating the telecommunications supply chain. Specifically, we investigate, in an in-depth case study, the efforts of a global manufacturer of infrastructural equipment for mobile telecommunications networks (hereafter MobInfra, a pseudonym), to create system-to-system integration supported processes toward its customers, telecommunications operators. We contribute to supply chain and operations management research on supply chain integration by providing empirical observations on what a contemporary e-business standard such as the RosettaNet can and cannot do in terms of integrating the supply chain at the business process level. This contribution is important, since considerable ambiguities surround related concepts, including the concept of supply chain integration itself, as pointed out by several recent literature surveys (Fabbe-Costes and Jahre, 2007; van der Vaart and van Donk, 2008). We further report the

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discovery of several enabling mechanisms necessary to create e-business enabled operational linkages in the studied context. In particular, we emphasize the importance of appropriate dyadic standardization of trade item data.

The structure of the paper is as follows. We first review prior literature on e-business enabled operational linkages and the RosettaNet standard in interorganizational system-to-system integration (Section 2). Next, we describe our research design (Section 3). This is followed by the exhibit of our empirical results (Section 4). In Section 5, we conclude our study and develop propositions for further research. Evaluation of contribution and notes on further research follow.

2. E-business enabled operational linkages

The use of e-business approaches is critical in enabling modern-day operational linkages in practice (Bowersox et al., 1999; Lee and Whang, 2001). While different kinds of operational linkages between two transacting organizations are many (e.g. just-in-time systems (Schonberger, 2007), vendor-managed inventory systems (Kauremaa et al., forthcoming), collaborative planning forecasting and replenishment systems (Danese, 2007), or integrated demand chains (Heikkilä, 2002), we focus on one specific kind: Situations in which the exchange of messages between the transacting organizations is fully automated. We designate this *interorganizational system-to-system integration* (see, e.g. Emmelhainz, 1990; Linthicum, 2001; Bussler, 2003, for related terminology on the same phenomenon).

The broader context of e-business enabled operational linkages, supply chain integration, is overviewed in Section 2.1. Two particular standards for interorganizational system-to-system integration—one established, electronic data interchange (EDI), and one emerging, RosettaNet—are reviewed, with emphasis on the latter, in Section 2.2.

2.1. Supply chain integration

Supply chain integration is commonly seen as the key goal of supply chain management (Frankel et al., 2008). Review of supply chain and operations management literature on supply chain integration reveals several distinct levels of discussion. At the relational level, the intention is to create facilities for interorganizational cooperation (Cooper et al., 1997; Lee, 2000; Mentzer et al., 2001; Chen and Paulraj, 2004; Christopher, 2005; Lambert et al., 2008; Fawcett et al., 2008), in order to nurture buyer–supplier relationships and improve decision-making within the supply chain. At the operational level, the intention is to integrate interorganizational business processes related to material, information, and financial flows (Venkatraman and Zaheer, 1990; Srinivasan et al., 1994; Lee et al., 1997; Walton and Gupta, 1999; Supply-Chain Council, 2005).

Following this we define for our purposes *supply chain integration* broadly as the relational and operational coupling of autonomous businesses along a supply chain in order to increase revenues, decrease costs, and improve asset utilization (see Fig. 1). We refer to the operational level of supply chain integration as the creation of *operational linkages*, defined as the degree to which the systems, procedures, and routines of the buying and selling organizations have been linked to facilitate operations (Cannon and Perreault, 1999, p. 442). In terms of information exchange, we regard the fully automated interorganizational system-to-system exchange of messages as the deepest level of integration.

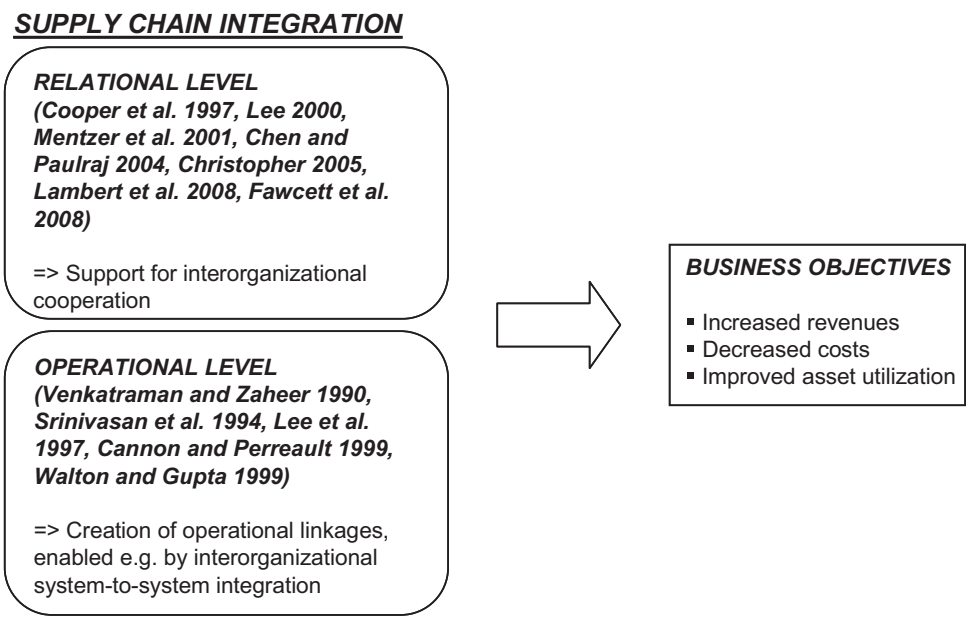

Fig. 1. A broad schema of supply chain integration.

2.2. EDI and RosettaNet standards

EDI and RosettaNet are particular kinds of *e-business standards*: a class of standards designed to support integration of interorganizational business processes via system-to-system exchange of messages (Bussler, 2003; Boh et al., 2007). The most widely known and still actively used EDI standards are the ANSI X.12 standard in the United States and the global EDIFACT standard of the United Nations. In general, EDI standards date back to the 1980s (Emmelhainz, 1990). Accordingly the impacts and adoption of EDI have been studied extensively (Elgarah et al., 2005; Narayanan et al., 2009). However, a common view is that EDI has fallen short of some expectations. Specifically, traditional EDI has been criticized for its complexity, high implementation costs, and reliance on proprietary networks (the so called value-added networks [VANs]) (Goldfarb and Prescod, 2004; Wigand et al., 2005; Johnston et al., 2007), making it available first and foremost to larger organizations. In addition, evidence exists that EDI-enabled information flows have been implemented in several instances only in a half-automated way, thus forgoing the benefits of a fully automated information exchange process (Benjamin et al., 1990; Riggins and Mukhopadhyay, 1994; Angeles et al., 1998; Markus, 2000; Truman, 2000; Mukhopadhyay and Kekre, 2002).

Recently, management information system scholars have been promoting modern e-business standards as key enablers of efficient and flexible operational linkages between trading partners in the supply chain (Gosain et al., 2003, 2004; Bala and Venkatesh, 2007; Malhotra et al., 2007; Chong and Ooi, 2008). In all of these cited instances, the particular e-business standard used, as a case in point, is the RosettaNet standard, developed since 1998 by a group of companies coming mainly from high-technology manufacturing industries.

RosettaNet (2008) develops "robust open business process standards, encompassing data dictionaries, implementation framework, and XML-based business message schemas and process specifications". Thus, in effect, the RosettaNet standard is a complete message exchange standard, in the sense that it defines not only the message content, but also other interoperability issues relevant in interorganizational system-to-system integration, such as messaging sequence and security issues (Bussler, 2003). Obviously, RosettaNet is not the only contemporary e-business standard (for a review see Nelson et al., 2005; Chituc et al., 2008) but it has gained significant penetration, at least among high-technology manufacturing sectors, such as semiconductor and electronic components manufacturing (Damodaran, 2004; RosettaNet, 2004; Cartwright et al., 2005; Löwer, 2006; Boh et al., 2007; Chituc et al., 2008). The key components of the RosettaNet standard are the Partner Interface Processes (PIP), which specify the message content and message exchange sequences, and the RosettaNet Implementation Framework (RNIF), which specifies the message transmission infrastructure (Bussler, 2003; Damodaran, 2004). RosettaNet stores consistent definitions of business terms and data structures used in PIPs in a dictionary called the RosettaNet Business Dictionary (Damodaran, 2004). A dictionary is also used within RosettaNet for exchanging products. Related product data are defined in the RosettaNet Technical Dictionary (RNTD) (Damodaran, 2004). RosettaNet also supports the Data Universal Numbering System (DUNS) for trading partner identification, Global Trade Item Number (GTIN) for product and service identification, and United Nations Standard Products and Services Code (UNSPSC) for product and service classification (Bussler, 2003).

Empirical work on the utilization of RosettaNet is scarce. Lu et al. (2006) report critical success factors from an implementation of an operational linkage between Cisco and Xiao Tong in China in purchase order processes. Gosain et al. (2003, 2004) have argued, based on empirical data from RosettaNet-based integrations, that contemporary e-business standards, such as the RosettaNet, offer a way of creating flexible integrations between trading partners. Malhotra et al. (2007) and Bala and Venkatesh (2007), both use RosettaNet as a particular example of a contemporary e-business standard, overcoming problems related to the traditional EDI standards. Malhotra et al. (2007) find that such standards can be leveraged to build adaptive supply chain partnerships. Bala and Venkatesh (2007) study the factors explaining the adoption of such standards. Chong and Ooi (2008) study empirically the adoption factors of RosettaNet standards within the Malaysian electronics industry and find "partner's power", "trust", and "products' characteristics" having influence on adoption.

Notably, all of these prior works draw data from the semiconductor and electronic components manufacturing industries, the breeding grounds of RosettaNet. As such, the role that the RosettaNet standard plays in dyad-level beneficial system-to-system integration beyond these contexts remains unclear. Further, independent of this, as for any technology, there is a constant need to evaluate new approaches to older ones; here specifically, the value of RosettaNet over traditional EDI (e.g. Reimers, 2001).

2.3. Research motivation

With the recent suggestions of the benefits of contemporary e-business standards, RosettaNet in particular, and the noted shortcomings of the traditional EDI standards this paper focuses on the following research question:

> RQ: What is the role of the RosettaNet standard in interorganizational system-to-system integration in the context of telecommunications equipment supply from both the supplier's and the buyer's perspectives?

RosettaNet is studied, as it is a widely used contemporary e-business standard, in terms of number of companies and implementations. Further, the telecommunications context is interesting in this paper for two reasons: Firstly, evaluations of RosettaNet-based integrations beyond the semiconductor and electronics components manufacturing industries are scarce; secondly, we had access to several companies within the telecommunications industry, thus the choice of the telecommunications equipment supply

context in particular. We focus particularly on the dyad-level perspective, as the deployment of operational linkages is inherently a dyad-level phenomenon.

3. Research design

3.1. Overall research approach

This study follows an exploratory theory building single case study approach with embedded units (Eisenhardt, 1989, Yin, 1994, pp. 38–41) in order to increase understanding of the role of RosettaNet in supply chain integration. The study is exploratory due to little prior empirical research and with current literature base ambiguous in warranting specific *ex ante* hypotheses, especially related to the use of RosettaNet standard in operational level supply chain integration, especially within the telecommunications context.

3.2. Overview of the case and study context

The studied case is the deployment of RosettaNet-based integrations of MobInfra, a manufacturer of infrastructural equipment for mobile telecommunications networks, toward its customers, telecommunications operators, in Europe. The embedded units are specific ongoing or complete customer-facing deployments of system-to-system integrations within specific business processes.

The study is conducted within the telecommunications industry. Stated in broad terms, the telecommunications equipment manufacturers (original equipment manufacturers or OEMs) develop and manufacture the various network equipment goods (e.g. base stations, network switching systems, routers, and switches), which the operators acquire to build networks. In addition, the OEMs provide maintenance, repair, and operations services to the operators. Operators, who usually have several OEM suppliers for network equipment goods (Agrell et al., 2004), operate the networks to offer fixed or mobile data and voice services to consumer and business customers.

In general, the telecommunications industry has been facing increased cost pressures and competition. The *E-business Watch* (2006, pp. 25–26) report on the telecommunications industry identifies four specific reasons for this trend, dating back to the 1990s: (1) market liberalization and regulation; (2) convergence of platforms and technologies; (3) market saturation in conventional segments; and (4) low return on investment in third generation (3G) mobile networks. Accordingly, major operators and OEMs have actively participated in developing e-business standards, especially EDIFICE (a subset of EDIFACT) and RosettaNet, the latter of which developed within the RosettaNet Telecommunications council (established in 2003).

3.3. Study phases and data collection

Data were collected in three phases in October 2006–June 2008. First, pre-study interviews were made with MobInfra's representatives. Second, from December 2006 until April 2007, we conducted a dyadic in-depth evaluation of the supply processes between MobInfra and two European operators, Alpha and Bravo (pseudonyms). Collecting data from both MobInfra and Alpha/Bravo representatives, we focused on the current and desired state of the supply processes as well as perspectives on e-business and the RosettaNet standard. Alpha and Bravo represented two same-sized customers operating in the same geographic region, thus enabling the control of two important external sources of variation. Moreover, with both customers, MobInfra had plans at the start of this study for future system-to-system integrations, thus making the inquiry into these matters more fruitful. In the third data collection phase, we followed the MobInfra–Alpha system-to-system integration project and its impacts, from August 2007 until June 2008, in order to gain insights into an ongoing implementation project and to collect data on those impacts.

We supplemented the main data collection by comparing MobInfra's e-business integrations with Alpha and Bravo to four other MobInfra's customer-facing system-to-system integrations (with operators we designate as Charlie, Delta, Echo, and Fox). These four cases were selected with the help of our contacts at MobInfra to illustrate different kinds of customer integrations. Data on these four supplementary cases were collected only from MobInfra's perspective (the related e-business project managers in question as our informants), due to access restrictions. For an overview of the organizations related to the study see Table 1.

The main data for this study were collected through semi-structured interviews. Throughout the study, we maintained close contact with MobInfra's representatives who provided us with contacts and key informants within MobInfra and helped us also find starting points for contacts with Alpha and Bravo. In all, we conducted 51 interviews with 32 informants among three organizations (see Table 2), in order to address the questions in our interview protocol (see Appendix A). The interview protocol was developed to explore the overall research goal—role of the RosettaNet standard—from multiple standpoints. In particular, the aim was to understand different kinds of practical implementations and their benefits for both dyad parties. In order to understand these, we also had to discover the background and business context of the studied organizations, as well as the present conduct of business process between the studied operators and telecommunications equipment manufacturers in general and MobInfra in particular.

For each interview protocol item, we searched the best possible informant in each organization with the help of our MobInfra contacts, our contacts at Alpha and Bravo, and our informants, by asking who would be most knowledgeable on each topic. We then conducted as many interviews as required to cover our data needs as defined in our interview protocol. The typical interview lasted from one to three hours and involved two researchers and one to three informants. Each interview was audio taped and a field note document, based on notes taken during the interview and the audiotape, was sent to the informant(s) to confirm.

Table 1
Overview of organizations related to the study.

Organization	Dyadic role	Main role in this study	Main line of business	Presence
MobInfra	OEM	Focal company	Mobile telecommunications equipment development and manufacturing	Global
Alpha	Operator	Customer to MobInfra (studied in-depth)	Mobile+fixed data and voice services	Focused in one European country
Bravo	Operator	Customer to MobInfra (studied in-depth)	Mobile+fixed data and voice services	Focused in one European country
Charlie[a]	Operator	Customer to MobInfra (supplementary study)	Mobile+fixed data and voice services	Focused in several countries (within and outside Europe)
Delta[a]	Operator	Customer to MobInfra (suppl. study)	Mobile data and voice services	Focused in one European country
Echo[a]	Operator	Customer to MobInfra (suppl. study)	Mobile data and voice services	Focused in several countries (within and outside Europe)
Fox[a]	Operator	Customer to MobInfra (suppl. study)	Mobile data and voice services	Focused in one European country

[a] Data on these organizations as used in this study were collected through publicly available information and interviews with MobInfra representatives due to access restrictions.

Table 2
Summary of interviews and informants for each study phase by organizations.

Phase	Number of interviews/informants			
	MobInfra	Alpha	Bravo	Total
Pre-study	7/7	–	–	7/7
In-depth study (MobInfra–Alpha)	4/5	5/5	–	9/10
In-depth study (MobInfra–Bravo)	4/5	–	7/6	11/11
Study of implementation (MobInfra–Alpha)	12/4	6/3	–	18/7
Supplementary data collection	6/5	–	–	6/5
Total interviews	**33**	**11**	**7**	**51**
Total informants[a]	**19**	**7**	**6**	**32**

[a] Singular informants.

3.4. Data analysis procedures

Data analysis spanned the data collection phase and was continued afterward. In general, we focused analyses on three subjects: (1) MobInfra's history, objectives, and perceptions on system-to-system integration toward its customers, in particular, using the RosettaNet standard; (2) MobInfra's customers' perspectives on system-to-system integration toward MobInfra, in particular, using the RosettaNet standard; and (3) evaluation of success of past and current system-to-system integrations between MobInfra and its customers. A key method of analysis was making short descriptions of implementation cases and of perceptions on system-to-system integration, then comparing each case for similarities and differences.

3.5. Assessment of validity and reliability of the study

In general, the case study method has been endorsed by several operations management (e.g. Meredith, 1998; Dubois and Araujo, 2007) and management information systems scholars (Benbasat et al., 1987; Lee, 1989) as an important empirical research method along with more common hypothetico-deductive survey-based research designs. In particular, the case study approach is strong in an area with few previous studies (Benbasat et al., 1987, p. 370) as is the case with the RosettaNet standard. Further, we selected a single case design to which we had access through Mobinfra. Our access to the telecommunications industry corresponds to Yin's (1994, p. 40) suggestion that single case study designs are appropriate with a case previously inaccessible for researchers. Finally, albeit a single case study, our embedded design with six individual integrations enabled effectively a cross-case analysis setup needed for a theory building case study approach (Eisenhardt, 1989).

As typical in case study research, our data is primarily of qualitative nature. We concur with Miles and Huberman that properly collected qualitative data has the strength of focusing on "naturally occurring, ordinary events in natural settings, [to] … have a strong handle on what 'real life' is like" (Miles and Huberman, 1994, p. 10). However, the overall quality of a case study needs to be assured. Our key means of addressing validity and reliability concerns were as follows:

Firstly, we used multiple sources of evidence (Yin, 1994, p. 13) to enhance construct validity. In particular, we

interviewed numerous knowledgeable informants from multiple organizations (see Table 2) who viewed the focal phenomena from diverse perspectives, matching thus Eisenhardt and Graebner's (2007, p. 28) suggestion relating to interview data use within a case study. In addition, we collected supplementary data from MobInfra, such as overall data on its customer facing system-to-system integrations (number and type of integrations).

Secondly, we further fostered construct validity by providing our informants and other experts in the industry opportunities to comment on the intermediary results of our analyses. First, detailed reports of MobInfra–Alpha and MobInfra–Bravo interorganizational business processes and perceptions on the RosettaNet standard were prepared and sent for our informants to comment upon. A similar detailed report was also prepared of the MobInfra–Alpha system-to-system integration project, again checked by our informants. Second, an overview summary of all collected data (except the MobInfra–Alpha implementation case experience, as it was not yet complete at that time), was prepared and this summary report was sent to our key contact persons in the studied organizations. During this phase, three public presentations of the tentative research results were also given. The most important was a presentation in fall 2007 to a meeting of a European professional association on e-business and e-business standards.

Thirdly, internal validity was supported with systematic pattern matching within and between the analyzed MobInfra-operator integration cases, guided by our research question (see Section 3.4).

Finally, to secure reliability we deployed an explicated interview protocol (see Appendix A) and constructed a systematic case study data-base. The case study data-base, maintained as a file system within Microsoft Windows, includes, among other things, interview memos, interview audio tapes, interview notes, memos of informal discussions with informants, publicly available material related to the collected data, supplementary material received in or through the interviews, intermediary study reports given to the studied organizations, and our immediate reflections on emerging study themes.

The key threat to the quality of the study comes from concerns on external validity. While we compared the individual embedded implementations in a cross-case manner with carefully selected cases as suggested by Yin (1994) and Eisenhardt (1989), the findings and inferences are still limited by the study context. Most notable sources of idiosyncrasies include the nature of telecommunications network equipment products (configurable products with hierarchical structure), the RosettaNet standard, and system-to-system integration in customer-interface.

A further limitation in this study is limited access to empirical data. Data collection proved challenging, especially gaining access to informants at telecommunications operators turned out quite difficult. Thus, from six evaluated MobInfra-customer integrations, four were based solely on informants from MobInfra. However, we have mitigated related concerns on validity by careful multi-informant data collection, collecting dyad-level data in instances where access was possible (operators Alpha and Bravo), and following longitudinally, employing a dyad-level data collection, one implementation project (the MobInfra–Alpha integration).

4. Case study of customer-facing system-to-system integrations at Mobinfra

4.1. Understanding dyadic perspectives on the RosettaNet standard within the telecommunications context

4.1.1. Mobinfra

MobInfra joined the RosettaNet consortium in 2001 and implemented the first RosettaNet PIPs with its suppliers during the same year. RosettaNet soon became a preferred way for interorganizational system-to-system integrations toward both suppliers and customers. As a result, in 2003 MobInfra was one of the founding members of the RosettaNet Telecommunications council, along with several major OEMs and operators, in order to drive RosettaNet toward its customers, telecommunications operators. From a strategic perspective, MobInfra was convinced that RosettaNet is a global open standard, while traditional EDI was seen geographically fragmented, making RosettaNet an enabler of widespread adoptions. In particular, RosettaNet's key value was seen to lie in its capability of supporting the automation of various kinds of business processes, that is, extending system-to-system integrations to current non-automated interorganizational processes. In short, disclosed a MobInfra representative, RosettaNet was essentially about the *lingua franca* for e-business, in a global world spinning faster and faster, and calling for flexible integrations and disintegrations with various partners.

Compared to traditional EDI standards, the value of RosettaNet was perceived to lie in its process orientation, fast development, wider coverage of messages, and several technical details. Firstly, RosettaNet's message exchange process orientation has enabled MobInfra to use only two customized message mappings with 10 separate customers—traditional EDI would have called, on estimate, for separate mappings for each customer. Secondly, the development of RosettaNet has been fast since the standards development organization is industry driven, and a new PIP can be developed in up to six to eight months if a sufficient amount of organizations agree to participate. The industry-driven development efforts have also resulted in a wider coverage of messages than there are within the traditional EDI standards. Finally, several technical features of RosettaNet potentially enable the flow of messages to be more real-time and the signaling messages included in the standard confirm, for both transacting parties, that a message has been successfully delivered. No such feature exists in the EDIFACT standard, for instance.

By 2006, the total amount of MobInfra's system-to-system integrated partners was several hundred, dividing roughly equally between RosettaNet and EDI. At the same time, system-to-system integrations toward its customers were relatively scarce; only with 13 customers had

MobInfra created system-to-system integrations, and among these, not all were implemented with RosettaNet, but with older standards—several variants of EDI. But how did MobInfra's customers perceive RosettaNet? We evaluated this by collecting data from two operators, Alpha and Bravo.

4.1.2. Alpha and Bravo

Analysis into the role of the RosettaNet standard for MobInfra's two customers reveals important insights into the actual use of RosettaNet-based integrations in the studied context. This analysis is based on interviews with key persons related to the studied purchase processes at Alpha and Bravo. Detailed descriptions of Alpha's and Bravo's perspectives are shown in Case data display 1.

Principally, Alpha's perspective can be summarized with two notions. Firstly, purchases from telecommunications equipment suppliers constitute only a small portion of Alpha's transaction volume. This makes integration toward MobInfra a lower leverage point, be that with any e-business standard. Secondly, Alpha is highly interested in automating purchasing processes towards suppliers. However, it does not want to develop and cultivate in-house resources for external system-to-system integrations. Rather, it has chosen to resort to services of a third party integration service provider. Thus, the specific standard a supplier wants to use, say RosettaNet by MobInfra, is less relevant for Alpha.

Bravo, on the other hand, perceives—as does Alpha—telecommunications equipment purchases as a transaction-thin area, compared to transaction volume with for example network construction companies and other telecommunications operators. However, by contrast to Alpha, Bravo has chosen RosettaNet for further integrations carried out with MobInfra. In short: EDIFACT-based enhancement would have been "old fashioned". Thus, while RosettaNet may not, and indeed does not, solve all problems with traditional EDI standards, it remains for Bravo an e-business standard more effectively corresponding current business needs: Specifically, in terms of messages covered and flexibility in leveraging a once deployed integration with one partner in integration with another partner.

4.2. Evaluation of Mobinfra's customer-facing integrations

4.2.1. Adverse and cooperative e-business: categorization of six integrations

To further understand MobInfra's RosettaNet-based integrations in its customer interface data from six system-to-system integrations between MobInfra and its customers were analyzed (for summaries see Tables 3 and 4). We categorized the integrations into two classes: adverse (Alpha, Charlie, Echo) and cooperative (Bravo, Delta, Fox). This categorization is based on observed differences across the integrations among two aspects: (1) level of joint process alignment and (2) the criticality of use of a specific middleware tool developed and deployed by MobInfra. Illustrations on four integrations, two from both category, appear in Case data display 2.

Alpha's perspective on RosettaNet

Alpha has a strong will to move toward increased use of e-business in its purchasing operations, while at the same time, current level of e-business use is fairly low and the information system landscape fairly dispersed. To enable the wide penetration of electronic transacting, Alpha selected, in 2005, a third party integration service provider. Alpha's policy now is that suppliers can either connect to the service provider through a web-portal or alternatively pay for system-to-system integration themselves. A key reason for using the service provider is that point-to-point integration between two businesses and their backend systems is not, from Alpha's purchasing organization's point of view, an area where Alpha should cultivate and maintain internal resources.

As for the RosettaNet, Alpha's representatives see it as a prominent standard for the electronics industry. Whereas for Alpha, electronics industry purchases constitute only a small part of its total purchases. In fact, data on number of invoices (from 2006) from Alpha's purchasing systems show that there are roughly four to five times more invoice-messages in installation services and related materials and over 10 times more invoice-messages in the inter-operator business (services bought from other telecom operators) compared to invoices in all network equipment (fixed and mobile) purchases.

Bravo's perspective on RosettaNet

At Bravo, the use of e-business in mobile telecommunications equipment purchasing is relatively wide: all purchase orders leave electronically from the company's ERP-system. In addition, besides the ERP, a specific material logistics management system is used to control order-to-delivery process. Orders placed in the ERP-system are delivered to suppliers, who update delivery-related information into this system (typically manually, by using a web-portal interface).

As for RosettaNet, Bravo sees it as one standard among many other standards. And with RosettaNet the question is the same as for any other standard: Will it become widely accepted? From Bravo's point of view, it is difficult to evaluate this for RosettaNet. However, while RosettaNet currently may not be widely accepted from Bravo's perspective (especially concerning transactions with contractors and other operators), neither are there that many alternatives. For Bravo, in regard to telecommunications equipment purchases, it is important to deploy a method of messaging that does not tie to a single vendor and is easily possible with all potential vendors. However, a major concern for Bravo is that RosettaNet seems best suited for interactions between large companies, but not for smaller ones. This is an important question for Bravo, since many key trading partners are smaller players (e.g. the installation service contractors).

In further integrations with MobInfra, Bravo has chosen to use point-to-point RosettaNet. EDIFACT, for example, was seen old fashioned [see Case data display 2 on details of a prospective RosettaNet-based MobInfra-Bravo integration].

Case data display 1. Alpha's and Bravo's perspective on the RosettaNet standard (case summaries based on study interviews, checked by informants).

Table 3
Overview of the six evaluated MobInfra's customer-facing system-to-system integrations.

Integration with operator	Year of implementation	E-business standard	Order	Order confirmation	Order change	Shipment notification	Receipt notification	Invoice	Ticketing[a]
Alpha	2007	RosettaNet	C	C				C	
Bravo	1998	EDIFACT[b]	C[b]	[b]		[b]			[b]
Charlie	WIP[c]	RosettaNet	C				C	C	
Delta	2002	RosettaNet	C						
Echo	2005	RosettaNet	E[d]	C	C			E[d]	
Fox	2006	RosettaNet							C

C—clean slate (from manual to a system-to-system link).
E—enhancement (from an existing system-to-system link to a new system-to-system link).
[a] Message exchange relating to network failure cases (chiefly: failure announcements from operator to OEM, solution announcements from OEM to operator).
[b] There is a planned implementation with RosettaNet in order (update from EDIFACT), order confirmation, shipment notification, and ticketing messages (implementation project pending as of spring 2008, due to internal development projects at both dyadic ends).
[c] Implementation project in progress (as of December 2006).
[d] From EDIFACT to RosettaNet.

Table 4
Cross-case analysis of six MobInfra-operator integrations.

Integration with operator	Integration category[a]	Joint process alignment	MobInfra tool in use	Commonly defined list of orderable items
Alpha	Adverse	Some	Yes (critical)	Yes (sales packages)[b]
Bravo	Cooperative	Yes	Yes (not critical)[c]	Yes (sales packages)[b]
Charlie	Adverse	No	N/A[d]	No[e]
Delta	Cooperative	Yes	Yes (not critical)[c]	Yes (sales packages)[b]
Echo	Adverse	Some	Yes (critical)	Yes (other)[f]
Fox	Cooperative	Yes	No[g]	No[g]

[a] For illustrations of adverse and cooperative integrations see Case data display 2.
[b] Bundling of sales items (the lowest level in the product structure in the sales end of MobInfra) into entities (MobInfra's sales packages) that simplify the ordering process and the management of base station configurations.
[c] The MobInfra tool is/will be deployed, but only to enhance MobInfra's internal reporting capabilities, not to align the interorganizational process.
[d] Implementation WIP (as of 2006).
[e] Implementation WIP. However, MobInfra's e-business project manager saw prospects for this low in 2006, key reasons being disagreements on the contents of the order message and impossibility to agree on a defined list of orderable items (preferably, from MobInfra's perspective, the sales packages).
[f] MobInfra and Echo have otherwise agreed on a standardized list of items that Echo uses when placing orders to MobInfra.
[g] The ticketing process is different from order-to-cash processes (one message concerns one network failure report).

The integrations labeled as *adverse* are signified in the way the customers have more or less dictated the integration and/or have been reluctant toward changes to the interorganizational business process important to MobInfra. The main motivation for the customers in these integrations seems to have been direct cost savings, e.g. through receiving electronic invoices from suppliers in general.

We see the implementation between MobInfra and Charlie as the best example of an adverse integration, underscored by its work-in-process status (as of December 2006). The two organizations have been unable to settle on key process issues, such as the contents of the order message. Another integration labeled adverse is MobInfra–Echo, due to limited interorganizational process alignments from Echo's side (from MobInfra's point of view). However, a currently operational system-to-system link between MobInfra and Echo shows that even with a telecom operator less willing to change its process, there is something the supplier can do. MobInfra's insight was to develop a middleware tool that helps to adapt the varying telecom operator specific processes to MobInfra's internal processes and information systems (for example, allocating an order to a proper contract in its ERP-system).

The integrations we label *cooperative* are highlighted by mutual commitment to requisite process development within the integration project, with the prospective MobInfra–Bravo and operational MobInfra–Delta implementations as the prime examples. Overall, the main motivation within the cooperative cases for the customers has been to enhance the related business process, and not the direct cost savings, e.g. through electronic invoicing, *per se*, as is typical in the adverse cases. Within the cooperative approach there also have been implementations or intentions to implement new processes previously without system-to-system data exchange. Evidence on this stems from the third cooperative implementation, the novel e-ticketing process between MobInfra and Fox, as well as the prospective shipping messaging implementation between MobInfra and Bravo.

To conclude, besides exhibiting the adverse-cooperative divide, the reviewed cases show from the point of

Illustrations of adverse integration:

(1) MobInfra-Charlie

In 2005, Teleoperator Charlie approached MobInfra and announced that it wanted to receive invoices in an electronic format from MobInfra. MobInfra became interested in automating the order-to-cash process toward this customer, toward which it also wanted to grow as a supplier. The integration project was started in 2005. However, by December 2006, the only thing that was ready was a partial integration of the order message exchange. The key challenge is that Charlie has been unwilling to make changes in the business process that would enable a fully automated process. In particular, Charlie cannot or will not deliver an order message in a format enabling MobInfra to automate the process. Moreover, another key problem is that the orderable product items are not standardized – for example, MobInfra's suggestion to deploy sales packages, bundles of specific sales items to simplify the ordering process has not been supported by Charlie. Accordingly, the details of the order message are still delivered via e-mail and broken down manually into MobInfra's enterprise resource planning (ERP) system. As Teleoperator Charlie seems not to be willing to make required changes to enable complete order automation, the implementation of a fully automated interorganizational order-to-cash business process appears to be in an impasse.

(2) MobInfra-Echo

MobInfra and Echo agreed on an implementation project in one European country (the Focal Country). The background to the project was Echo's need to consolidate its internal structure, dispersed in multiple relatively autonomous country organizations. In the first phase, Echo decided to connect its major country organization to its major equipment suppliers by using a message hub through which all selected purchasing related messages flow. Prior the actual implementation a considerable time was used in agreeing on interorganizational process issues all of which were not fully resolved. In addition, during the implementation MobInfra built for its internal use a middleware tool, to better manage orders and invoices between its ERP and Echo's process in the Focal Country. The need to develop such tool was due remaining interorganizational process misalignments: The tool allowed MobInfra to unilaterally adjust the interorganizational process to match the data needs of its ERP-system.

In the end, both parties were satisfied with the implementation. As pursued, Echo obtained enhanced process visibility and data mining capabilities, as enabled by the integration. Echo's Focal Country organization, however, received only moderate benefits, as prior to the RosettaNet-based integration, an EDIFACT link was in place (in orders and invoices). For MobInfra, the number one benefit was to satisfy its customer's needs. The project was also good experience for MobInfra, giving valuable lessons for further RosettaNet-based system-to-system integration, including the development of the middleware tool to be used with other customers as well.

Illustrations of cooperative integration:

(1) MobInfra-Bravo

MobInfra and Bravo have been discussing a RosettaNet-based enhancement in order (update from EDIFACT dating back to 1998), order confirmation, shipment notification, and ticketing messages. In particular, Bravo has needed, for some time, to improve the automation of several inbound messages from MobInfra in order to have more timely information in its material logistics management system. MobInfra drove the RosettaNet as the way to do this enhancement. From Bravo's perspective there existed no other viable standards. EDIFACT, for example, seemed old-fashioned. Initiated in 2005, it was decided to do the project with RosettaNet messages. Other main issues that supported the selection of RosettaNet at Bravo were that RosettaNet with one supplier was perceived also to enable RosettaNet with other equipment suppliers. In addition, RosettaNet was seen as not too technically complex. The implementation project was pending as of spring 2008, due to internal development projects at both dyadic ends.

(2) MobInfra-Delta

Teleoperator Delta informed MobInfra in 2002 that it wanted to implement automated ordering using RosettaNet and commonly defined product catalogue. This integrated business process went live by the end of 2002. The integration has met its goals. Before the integration, Delta's engineers at each site made the orders, using their own product codes, and sent the orders via fax/e-mail to MobInfra. Now, after the integration, Delta and MobInfra have an agreed upon list of packages of orderable items, updated and maintained by Delta's representatives. MobInfra's representatives perceive that the key benefit for Delta has been the faster construction of networks. For MobInfra the benefits include reduced errors in orders and the need for fewer questions to Delta after an order has been received. Of course, MobInfra is also satisfied that it has successfully filled the request by its customer of implementing an automated ordering system.

Case data display 2. Illustrations of adverse and cooperative integrations between MobInfra and its customers (case summaries based on study interviews, checked by informants).

view of our key arguments as developed below (Section 5) something even more important: The notion of commonly defined list of orderable items. We observed a strong association between them and an operational integration beneficial for both MobInfra and its respective customers (see cases Alpha, Bravo, Delta, and Echo, and the underscoring negative example of Charlie [case Fox dealt with a divergent business process, the ticketing of network failures]). Especially, the data collected suggests that the definition of the so called sales packages has been particularly supportive of the desired efficiency benefits from the integrations for both trading partners.

The prime example here is the case Delta where along the RosettaNet link sales packages were deployed. This is a

way to package sales items (the lowest level in the product structure in the sales end of MobInfra) into entities that simplify the ordering process and the management of base station configurations. As a result, a base station configuration can be assembled for an order from only a few sales packages (compared to wider assemblage of sales items). A typical order of a configuration using sales items could consist of 10–15 sales items while the same order using sales packages could consist of three to four sales packages. Furthermore, while sales items constantly change, sales packages are more static due to a higher level of abstraction. Sales packages also potentially simplify the management of base station product configurations, because, instead of managing information on a customized configuration level, all configurations can be defined by using a limited set of standardized sales packages. A similar sales package approach has been in use in integration between MobInfra and Bravo. The approach to standardize packages of orderable items emerged key also in the detailed evaluation of the MobInfra–Alpha implementation, as disclosed next.

4.2.2. Mobinfra–Alpha: lessons from a system-to-system integration project

Finally, to further examine MobInfra's customer-facing system-to-system integrations, we report the results of a detailed longitudinal examination of an integration project between MobInfra and Alpha. After commercial discussions for approximately one year between Alpha and MobInfra—on who would pay for Alpha's third party integration services provider for messaging between the service provider and MobInfra—a system-to-system integration project was initiated in spring 2007. The project went live in June 2007 and was implemented with RosettaNet messages. However, from Alpha's point of view, the specific e-business standard was of no importance, because of its use of the third party integration service provider (Section 4.1.2). In order to manage the fully automated information flow of this adverse (Section 4.2.1) integration, MobInfra implemented the middleware tool as discussed (Section 4.2.1), since all data needed by MobInfra could not be delivered within the messages by Alpha (most notably the contract reference number, crucial for MobInfra's ERP, but not recorded in Alpha's ERP).

Notably, the integration did not immediately bring the desired benefits on manual work and error reduction on the dyadic level. In particular, the main concern for MobInfra was the implementation of the sales packages, perceived being crucial in securing the data integrity in the interorganizational process. Moreover, several information system problems appeared during June–August 2007: Alpha's ERP system had several defects, necessitating the use of a manual work-around. These matters were corrected in November 2007 when a general update was made to Alpha's ERP.

Alpha did not see the urgency of the MobInfra-advocated sales packages and accordingly did not, at first, push the implementation of the sales packages model in its internal processes to the fullest. As a consequent, there were still many errors in the ordering process under the first months of the system-to-system integrated process. MobInfra returned erroneous orders and Alpha re-sent the amended versions. A partial solution was reached by stricter ordering guidelines at Alpha. At the same time, more efforts were put into implementing the new ordering practices. By October 2007 about 80% of orders were made with the sales package approach, which began to show at MobInfra's end. At that time, key persons related to the process in question at MobInfra noted a clear decrease in their manual work and amount of errors.

By spring 2008, the integration had met its goals. All informants from both parties reported satisfaction with the new e-business enabled operational linkage (interviews in April/May 2008). The most important benefits were perceived to be reduced manual work and reduced errors at both ends of the dyad. The reduction in order errors was directly attributed by our informants to the use of sales packages in ordering (by spring 2008, practically all Alpha's orders were made with them).

The key issue here with important implications, as developed below in Section 5, is that the mere implementation of the system-to-system link in June 2007 did not in it self-yield the desired benefits: Process changes, in particular, the use of the simpler product structure (the sales packages), secured message integrity and thus a fluent process.

5. Conclusions and propositions from the case study

5.1. Overall conclusions on the role of the RosettaNet-standard

Our findings point to the limits of RosettaNet-based integration: The matter manifests itself in a more nuanced format than just putting the standard messages as given by RosettaNet in place. Essentially, we discovered that the RosettaNet standard alone was insufficient for creating system-to-system integrations that benefited both implementing parties at the dyadic level. This finding is important in light of the suggestion that newer e-business standards, such as the RosettaNet, would overcome the challenges of traditional EDI standards (Reimers, 2001; Goldfarb and Prescod, 2004). In particular, by adding to the syntactic (common language) and semantic (meaning) level of traditional EDI standards, the pragmatic level (intention of messaging) (Kubicek, 1992; Bussler, 2003) RosettaNet type of newer e-business standards have been claimed help to create more flexible and economical interorganizational system-to-system integrations (Reimers, 2001; Johnston et al., 2007). In particular we note that: (1) EDI does not have to be over value-added networks (VAN); indeed, Internet-based EDI is a growing area (Huang et al., 2008); (2) RosettaNet still calls for specific messaging infrastructure, i.e. a dedicated server, as is called for in EDI-based transactions, thus making RosettaNet, as the traditional EDI, still more accessible to larger trading entities; and (3) RosettaNet does not remove the need for interorganizational agreements and business process adjustments.

To address the observed shortcomings of RosettaNet-based integrations more systematically we next conclude this paper by developing two propositions for further research.

5.2. Proposition 1: exploitative and explorative system-to-system integrations

The overall conclusions above question the differential value of RosettaNet and implicitly also the value of other recently proposed e-business standards. The question becomes especially relevant for dyads having previously implemented EDI standards, in particular as many of the challenges with RosettaNet appear essentially very similar to prior EDI-based integrations. Fundamentally: Is there any value in replacing an older working integration with a RosettaNet-based approach? Based on our study, we conjecture that there is, but this depends on the type of the underlying business process in question.

In the context of organizational studies, March (1991) summarized two basic modes of learning: exploitation and exploration. Exploitation, according to March (1991, p. 85), is "the refinement and extension of existing competences, technologies, and paradigms" with "positive, proximate, and predictable" returns. Exploration, on the other hand, means "experimentation with new alternatives" with "uncertain, distant, and often negative" returns (p. 85).

In the context of interorganizational system-to-system integration we can, following Subramani (2004) and Sanders (2008), similarly divide the underlying business processes as exploitative (applying integration to processes with considerable installed base, such as order-messaging in the studied context) and explorative (applying integration to processes with little or no prior examples, such as shipment status and ticketing messaging in the studied context). Clearly, the division depends heavily on the industrial context. Subramani's (2004) study comes from the retail industry and, in that context, transmission of order and shipment status messages, for instance, fall to the category of refining existing competences rather than experimentation with new alternatives—contrary to what was the situation in our context of study.

Our study suggests that the key issue is whether or not the planned interorganizational system-to-system information exchange expands to a previously unexplored territory. We find that, when it does, newer e-business standards, such as the RosettaNet, the focus of this study, are relatively more valuable. The reason for this stems from multiple notions, including up-to-date technology and active industry-based development communities (the RosettaNet Telecommunications council in the case of the RosettaNet standard). On the other hand, in areas where integrations have already been done and prior standards exist—such as basic order messaging—it is relatively less valuable to do the integration with a newer standard, and questionable to change an older standard only for the purpose of replacing a previously working exploitative implementation to be done with a newer standard.

More formally, we propose based on the study:

Proposition 1. *The differential benefits of the RosettaNet standard are greater in business processes previously unexplored in the industrial context of the transacting parties.*

Interestingly, we encountered in our study few examples where OEM-customer integrations had been driven to these kinds of new territories (the only studied examples being the e-ticketing process in case MobInfra–Fox, and the prospective MobInfra–Bravo integration in terms of shipment status messaging). Thus, the true value of RosettaNet-based integrations seemed at the time of the study yet to be realized in the studied context.

5.3. Proposition 2: dyad-level standardization of trade item packages

Further, our empirical data exhibits that in instances where interorganizational system-to-system integrations were made functional and beneficial for both parties, complementary investments were commissioned. Three particularly relevant complementary investments observed were: (1) use of commonly agreed sales packages; (2) unilateral systems to adapt a misaligned process; and (3) investment to backend system capabilities. These findings elaborate the microeconomic research on the productivity implications of information technology (Brynjolfsson and Hitt, 1996; Brynjolfsson and Hitt, 2000; Dedrick et al., 2003). Of particular interest are Brynjolfsson and Hitt's (2000, pp. 24–25) two conclusions: (1) "a significant component of the value of information technology is its ability to enable complementary organizational investments such as business processes and work practices" and (2) "these investments, in turn, lead to productivity increases by reducing costs and, more importantly, by enabling firms to increase output quality in the form of new products or in improvements in intangible aspects of existing products like convenience, timeliness, quality, and variety". In our study, we discovered empirical examples of such complementary investments in the studied context—here, complementary investments to interorganizational system-to-system integrations being partly IT-based (unilateral middleware tool, backend system enhancements), partly organizational (sales packages).

The discovered notion of standardized sales packages is of particular relevance, since prior EDI research has overlooked the issue (e.g. Mukhopadhyay et al., 1995; Lee et al., 1999; Iskandar et al., 2001; Hill and Scudder, 2002; Jiménez-Martínez and Polo-Redondo, 2004; Lu et al., 2006). Our context of study is different from these prior studies, in the sense that the exchanged products could be ordered on multiple levels (MobInfra's sales items versus sales packages). Our observation was that the dyad-level definition and use of sales packages on the level that was least complex for both trading partners (i.e. sales packages encapsulating a number of sales items)

was particularly associated with integrations beneficial for both transacting parties. This was exhibited especially in the longitudinal analysis of the MobInfra–Alpha case, but also in the studied integrations of MobInfra–Bravo and MobInfra–Delta. As further evidence, one key issue in the impasse integration between MobInfra and Charlie was directly related to this matter. (As for the other two studied integrations: in MobInfra–Echo the parties had otherwise defined standardized item codes that Echo uses when placing orders to MobInfra; the MobInfra–Fox case, on the other hand, dealt with a special kind of inter-organizational process, the ticketing of network failures.)

In a more general sense, the question is about what we choose to call *dyad-level standardization of trade item packages*. With this we refer to an unambiguous definition of item code data of the exchanged products on the least complex level from the perspective of both trading partners. Indeed, standardizing the trade item codes between the trading partners is a key enabler of a true system-to-system information exchange for operational level business processes—an issue relevant not only to ordering process, but to any instance of operational level interorganizational information exchange where the key data element is the trade item exchanged (e.g. Vermeer, 2000). However, our observations exhibit a further twist to the matter: A situation where the customer-desired end products (in our case: base stations) are configurable from numerous low level trade items (in our case: MobInfra's sales items) which are unnecessarily fine-grained to the other trading partner, typically the customer (in our case to Alpha and Bravo). In this situation, a definition of preconfigured packages of trade items (in our case: MobInfra's sales packages) appears as one effective means to simplify related interorganizational data exchange by hiding unnecessary data complexity within these packages of trade items.

This trade item packaging is analogous with computer system sales: Computer manufactures sell their customers either specific modules, such as a motherboard, keyboard, or a memory unit or complete computers, rather than sub-components of a motherboard, for instance. Such packaging—incidentally, matching here with a modular structure of the physical products—enables fluent electronic transactions between end users and suppliers, say via a sell-side web-portal of a computer manufacturer or a wholesaler.

More formally, we propose based on the study:

Proposition 2. *Standardization of trade item packages on the least complex level for both trading partners is a prerequisite for dyad-level economically beneficial RosettaNet-based integration in the context of multi-level trade item structures.*

We should further note that defining these trade item packages can be done at least in two ways: (1) using explicitly the (public) e-business standard in question or (2) agree on the matter (privately) between the trading partners. As of (1), RosettaNet has an advantage over traditional EDI standards, when RosettaNet's RNTD is used in combination with the GTIN and UNSPSC standards (see Section 2.2). Interestingly, however, within our case study the chosen approach was rather (2), the use of bilateral agreements. Here again we then observe a non-use instance of the capabilities of the RosettaNet e-business standard to the fullest possible extent. Perhaps one reason here is that the RosettaNet-organization had ceased, at the time of the study, to actively develop the RNTD. However, we cannot rule out the conclusion that many practical problems of system-to-system integrations still remain organizational rather than technical issues.

6. Discussion

6.1. Contribution and implications

This study contributes by elaborating the role of the RosettaNet-standard in operational level supply chain integration. We contribute, firstly, by claiming that RosettaNet, an example of a relatively recent e-business standardization initiative prominent in particular in the semiconductor and electronic components manufacturing industries, would be beneficial in particular to business processes which have been previously non-automated in the specific context, i.e. processes with an explorative stance, compared to an exploitative stance. We further believe that there are good possibilities to extend this proposition to cover other newer e-business standards as well. Clearly, however, this potential extension is an issue calling for further empirical research on the use of various e-business standards within different contexts.

Secondly, we contribute by drawing attention to an issue overlooked in prior research: Dyad-level standardization of trade item packages. In particular, we conjecture that standardization of such packages on the least complex level for *both* trading partners is a prerequisite for dyad-level economically beneficial system-to-system integration in the context of multi-level trade item structures. Only when complexity is minimized and the central data element (i.e. item code of the exchanged product) of the interorganizational transaction is systematically communicated between the trading partners, we argue, can system-to-system integrations potentially lead to the intended benefits—essentially, automated and timely exchange of structured information. Testing this proposition carries the prospect of improved understanding of interorganizational system-to-system integrations beyond the commonly studied industrial contexts. If supported in further studies, this proposition has also concrete implications in terms of designing effective evidence-based system-to-system integrations within wider range of supply chain contexts.

6.2. Further research

One hallmark of theory building case study research is the development of propositions for further confirmatory research (Eisenhardt, 1989). We have accomplished this by carefully analyzing our case data and, through interpreting our findings against prior EDI research and organizational learning theory, by posing two specific propositions.

Clearly, testing these propositions is needed, in particular beyond the studied context.

An important shortcoming in our work, along with limitations discussed in Section 3.5 above, has been the unit of analysis used. On the one hand studying dyads, as we have, is very relevant—after all, this is the level at which integrations are realized. On the other, a set or network of companies might be, in several instances, a more pertinent focus. Indeed one key notion of many e-business standardization initiatives, the RosettaNet included, is the fluent integration among many companies, not just on dyadic level. However, while explicitly focusing on dyads, we had an implicit network focus by covering six of that time total thirteen customer-facing implementations by MobInfra, thus addressing at least some related concerns. But we do find that further research should more fully try to assess the value of newer e-business standards among a set of companies, and test whether the standards live up to their expectations in that context. Collecting data for such studies, though, might prove to be a formidable task.

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Appendix A. Interview protocol

Interview protocol A (Pre-study)

1. Background information on MobInfra
2. Telecommunications industry, MobInfra's customer interface, and use of e-business with customers
3. Information on the RosettaNet initiative from MobInfra's perspective
   - General information and historical background
   - Perceptions on past, present, and future of RosettaNet at MobInfra
   - RosettaNet with customers
4. Information on Alpha and Bravo

Interview protocol B1 (In-depth evaluations/Alpha and Bravo protocol)

1. Background information on Alpha/Bravo
   - Overview of Alpha/Bravo's business
   - Relationships with telecom equipment suppliers
   - Relationship with MobInfra
   - Description of key information systems, especially relating to the purchasing processes of telecommunications network equipment
2. E-business with telecommunications equipment suppliers (current status and objectives)
3. Perceptions on RosettaNet and comparison of RosettaNet to other e-business approaches, especially EDI
4. MobInfra as a telecom equipment supplier to Alpha/Bravo
   - Description of key business processes with Mobinfra (product information exchange, ordering, installation project management, invoicing, network maintenance and technical support, inventory reporting, collaborative forecasting)
   - Satisfaction with the current way these processes are conducted
5. Perceptions of RosettaNet use with MobInfra

Interview protocol B2 (In-depth evaluations/MobInfra protocol)

1. Overview of business and Alpha/Bravo as a customer
2. Business processes towards Alpha/Bravo
   - Current execution of business processes (product information exchange, ordering, installation project management, invoicing, network maintenance and technical support, customer inventory reporting, collaborative forecasting)
   - E-business with Alpha/Bravo: history, current status, and future plans

Interview protocol C (MobInfra–Alpha implementation)

1. Current status of the e-business project with MobInfra/Alpha
2. Description of the implementation
3. Evaluation of the impacts of the implementation (benefits and costs for MobInfra/Alpha)
4. Evaluation of success of the implementation (from Mobinfra's/Alpha's perspective)
5. Perceived future e-business plans with MobInfra/Alpha

Interview protocol D (MobInfra e-business implementations with Charlie, Delta, Echo, and Fox)

1. Background of the implementation
2. Scope of the implementation
3. Before-after process description
4. Implementation process description and evaluation of its success
5. Evaluation of the impacts of the implementation (benefits and costs for MobInfra/customer)
6. Evaluation of success of the implementation (from Mobinfra's/customer's perspective)

Notes: (1) Each theme (numbered) or subtheme (bulleted) included specific ex ante prepared guiding questions, which are omitted here for space considerations. (2) Interview guides for individual interview sessions were customized based on informant expertise.

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