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Business-to-business integration: Applicability, benefits and barriers in the telecommunications industry

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ABSTRACT

This paper statistically analyzes applicability of business-to-business integration (B2Bi), benefits from and barriers to electronic data interchange (EDI) and RosettaNet between major original equipment manufacturers and European operators in the telecommunications industry. Based on coordination costs and nine business processes, frequency of the business process and timeliness required in the business process have clearer positive influences on applicability of B2Bi than does accuracy required in the business process. Complexity of the business process does not have such a positive relation to this applicability. Comparison of 12 benefits and eight barriers between EDI and RosettaNet shows no considerable differences. RosettaNet yields only slightly higher direct benefits than EDI, whereas all indirect benefits from RosettaNet are significantly higher than indirect benefits from EDI. Surprisingly, barriers to RosettaNet are not lower than barriers to EDI although only a lack of knowledge on EDI or RosettaNet is a significantly higher barrier to RosettaNet.

1. Introduction

For over three decades companies have used *Electronic Data Interchange* (EDI) that is the interorganizational exchange of business documents in a structured machine-processable format [14]. There is empirical evidence that EDI can save money and time [24,32,33,40,45]. EDI is an important part of *electronic business* (e-business) that covers the use of information and communication technologies (ICT) in all kinds of business activities. However, EDI focuses on business documents. *Business-to-business* (B2B) *integration* refers to all business activities that have to do with the electronic exchange of business documents between the companies [5]. B2B integration (B2Bi) extends EDI by emphasizing that these business documents are exchanged as electronic messages following *public* business processes, i.e. business processes between the companies [5]. Respectively, business processes within the company are *private* business processes.

Standards play a key role in B2Bi [5,30,37,44]. A *data format* defines the data structures and data elements in general. *Accredited Standards Committee X12* (ASC X12), *EDI for Administration, Commerce, and Transportation* (EDIFACT), and *Extensible Markup Language* (XML) are data formats. An *e-business framework* uses a data format to specify the data structures, data elements, and their purposes in the business context [36]. ASC X12 and EDIFACT are also EDI-based e-business frameworks, whereas RosettaNet is an XML-based e-business framework.

The number of empirical studies on XML-based e-business frameworks is modest compared to EDI-based e-business frameworks [13]. Now, a few empirical studies [2,3,6,8,18,26,28] deal with RosettaNet. Transaction costs provide an approach that has been utilized in some studies on B2Bi [13]. These studies have focused on business relationships and motivation costs in terms of asset specificity or uncertainty, while business processes and coordination costs in terms of timeliness or accuracy have received very little attention. There are findings that higher frequency of transactions or complexity of products works for B2Bi [8]. Moreover, benefits from and barriers to B2Bi have been compared much more often between different kinds of companies than between EDI-based and XML-based e-business frameworks. According to some studies, RosettaNet is superior to EDI-based e-business frameworks [18,28]. This paper strives to be the first study that analyzes statistically the effects of frequency, complexity, timeliness, and accuracy on B2Bi at the level of business processes, and benefits and barriers between older EDI-based and newer XML-based e-business frameworks.

The telecommunications industry offers the possibility to study B2Bi in a context outside the typically studied automotive and retail industries [10,20,21,24,27,33,45]. In fact, only few studies have delved B2Bi in the telecommunications industry [39]. Given the growing demand for e-business in the telecommunications industry [25,39], it is important to understand factors that significantly

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facilitate or inhibit B2Bi and especially newer XML-based e-business frameworks when original equipment manufacturers (OEM) are suppliers and operators are customers. Since B2Bi can demand considerable investments, decisions about B2Bi, i.e. which business process are supported by which e-business frameworks, should be made carefully. Three research questions arise over B2Bi. How frequency or complexity of the business process or timeliness or accuracy required in the business process affects applicability of B2Bi? Are benefits from RosettaNet higher than benefits from EDI? Are barriers to RosettaNet lower than barriers to EDI? In this paper, EDI refers to certain EDI-based e-business frameworks, i.e. ASC X12, EDIFACT, EDI Forum for Companies with Interests in Computing, Electronics, and Telecommunication (EDIFICE), and Electronics Industry Data Interchange (EIDX), which have been used in the telecommunications industry. B2Bi covers both EDI and RosettaNet.

The paper proceeds by introducing B2Bi, coordination costs, EDI and RosettaNet, the telecommunications industry, business processes, and benefits and barriers. Next, the paper presents the research approach which is based on the survey data of perceptions and the statistical analysis of sample means. Then, the paper studies one factor measuring and four factors explaining applicability of B2Bi in nine business processes, and 12 benefits from and eight barriers to EDI and RosettaNet. The factors explaining applicability are based on coordination costs [29,31,50,51]. The benefits and barriers partly follow some empirical studies [4,12,20,34]. Finally, the paper discusses contributions, limitations, and further research, and presents conclusions.

2. Background

2.1. B2Bi

The purpose of B2Bi is to automate *business interactions*, i.e. the exchange of business documents in the public business process. In order to harmonize the meanings for terms, the modes of operations, and the messaging interfaces for B2Bi, the e-business frameworks specify the business documents, business processes, and messaging [36]. Without automation of the exchange of business documents in the private business process, B2Bi does not necessary work well. Effective and efficient B2Bi may require enterprise application integration (EAI) and even business process reengineering (BPR) [22].

2.2. Coordination costs

Williamson [51] has introduced three sources of *transaction costs* that are asset specificity, uncertainty, and *frequency*. Transaction costs can be divided into *motivation costs* that are associated with incentives and *coordination costs* that stem from information processing and communication [31]. Asset specificity and uncertainty cause motivation costs, while frequency also affects coordination costs. Milgrom and Roberts [31] recognize *complexity* of the transaction that is the connectedness of the transaction to other transactions. Malone et al. [29] propose complexity of the product description that is the amount of information needed to specify a product. Moreover, delays and errors result in coordination costs [31]. *Timeliness* reflects how less the system state differs from the real-time state, whereas *accuracy* depicts the similarity between the system state and the real-world state [50]. The system can get stuck in the past state due to the delay or end up in the fallacious state due to the error.

The frequency or volume of transactions has been found to facilitate B2Bi [8,46]. When transactions recur with higher frequency, investments in integration are easier to recover [51]. Considering B2Bi, frequency of the business process is proportional to the periodic volume of business interactions. For these reasons, applicability of B2Bi should be higher/lower in a more/less frequent business process. The complexity of products has also been observed to advance B2Bi [8]. Products with complex descriptions are more likely to be obtained through integration [29]. Complexity of the business process refers to the information in business interactions and the dependences between business interactions. A more complex business process demands more information processing and communication due to a larger amount of information in a business document or a greater number of business documents than a less complex business process. Since B2Bi can reduce information processing and communication costs [33], applicability should be higher/lower in a more/less complex business process.

The empirical studies on timeliness and accuracy in B2Bi are rare although B2Bi can reduce delays and errors [32,40,45]. Timeliness required in the business process is associated with the costs of delays and accuracy required in the business process is related to the costs of errors in business interactions. Based on the theoretical considerations [48,50], applicability should be higher/lower in a business process requiring higher/lower timeliness or accuracy. If the cost of the delay is high, the business process requires high timeliness, and the duration of the delay should be small in the business interaction. Respectively, the business process requires high accuracy, and the probability of the error should be small in the business interaction when the cost of the error is high.

2.3. EDI and RosettaNet

ASC X12 is an EDI-based e-business framework for all industries in North America, and EDIFACT for all industries, especially in Europe. They specify the structure of business documents and provide a dictionary of terms for these business documents. Furthermore, EDIFICE is an EDI-based e-business framework for the European electronics and ICT industries, and EIDX for the North American electronics and ICT industries. For a part of business documents, EDIFICE is a modified subset of EDIFACT and EIDX a modified subset of ASC X12. However, EDIFICE and EIDX are more comprehensive than ASC X12 and EDIFACT. They provide guidelines for public business processes where business documents are exchanged. They also recommend EDI over the Internet (EDIINT) in messaging instead of the value-added networks (VAN).

RosettaNet is perhaps the most successful XML-based e-business framework [11]. It has been designated for the electronics, ICT, and logistics industries in the worldwide. RosettaNet covers business documents, business processes, and messaging. The corner stone of RosettaNet is Partner Interface Process (PIP) that provides a building block of the business process. PIPs are detailed specifications of the public business processes and associated business documents. They set requirements for quality of service (QoS) in B2Bi. RosettaNet also includes RosettaNet Business Dictionary and RosettaNet Technical Dictionary which provide terms for the PIPs. RosettaNet Implementation Framework is the messaging interface used to execute the PIPs over the Internet.

Nurmilaakso [35] argues that since companies have not locked into EDI-based e-business frameworks such as ASC X12, EDIFACT, EDIFICE, and EIDX, XML-based e-business frameworks such as RosettaNet have advantages. EDI-based e-business frameworks have disadvantages in terms of inflexibility and costs, and their use is limited to a few business processes [18,28,38]. Correspondingly, XML-based e-business frameworks are mostly global, can take into account industry-specific needs in detail, rely on widespread technologies, and often specify business processes and messaging