

Understanding the challenges in an international diffusion of a technological innovation – Case cross-border electronic invoices

Abstract

This paper examines the international diffusion of a technological innovation. Using the Rogers (1995) innovation diffusion framework, we pinpoint the challenges in the large-scale diffusion of electronic invoicing. We present the case Finnair and find that the innovation characteristics (relative advantage, compatibility, complexity, trialability, and observability) do not provide a good explanation to the slow rate of adoption of international electronic invoicing. Rather, our study highlights the importance of the extent of change agents' promotion efforts and the nature of the social system. Governmental organizations are in a key position to create the means and take down the barriers related to the cross-border electronic invoicing.

Keywords: Innovation diffusion, international invoicing, case study

Introduction

Electronic invoicing has been recognized by the European Commission as one of the most important sources of productivity increases in Europe (EEI 2007). Some European countries have been more active than others in enforcing the transition to electronic invoicing. As an example, since 2005, Denmark's public authorities primarily receive invoices in electronic format and this has been stipulated by law (Brun 2007). Similarly, the Italian government has introduced a proposal in the state budget law to make electronic invoicing mandatory for all companies dealing with the central government beginning in the summer 2008. In Finland, beginning in 2010, all companies that are suppliers to the Finnish government have to submit their invoices in electronic format.

In Europe, the annual volume of invoices (B2B and B2C) total 30 billion and the benefits of moving from paper-based invoicing to electronic invoicing are clear (Billentis 2007). By moving to electronic invoicing, the costs of handling invoices can be lowered considerably. According to the European Associations of Corporate Treasurers (EACT), the resulting cost reductions in the supply chain expenditures total 243 billion Euros across Europe (EEI 2007). In addition to the monetary savings, there are considerable environmental effects as the transition from paper bills to electronic invoicing in the EU alone would save over 14 million trees annually (estimates of, e.g., Pagero and PayItGreen).

Electronic invoicing is not something totally new. Invoices have been transmitted in electronic format for decades. Already in the 1970s, EDIFACT was used by large companies as a means to exchange invoice data. These systems were point-to-point systems, and required somewhat heavy investments in establishing the connection between the two companies or organizations. In this paper, however, we leave these legacy systems out of our scope and define electronic invoices as invoices transmitted through XML-based open standards, e.g., Finvoice or the TEAPSSXML standard in the Finnish context. Our focus is on the automation of invoicing processes and this in turn requires that the invoice data is sent in a structured format. Therefore, invoices that are transmitted as attachments (PDFs etc) in e-mails are not considered as electronic invoices. This is because e-mail attachments do not allow for the invoice data to be automatically processed in the payment system.

Despite the potential gains of electronic invoicing, especially the international, cross-border electronic invoicing diffusion has been very slow (Billentis 2007). Therefore, the objective in this study is to examine the challenges in the diffusion of electronic invoicing in cross-border invoicing. To do this, we apply the diffusion of innovations framework (Rogers 1995) and conduct a case study at Finnair, which is the national airline in Finland. We focus on incoming invoices. The company receives around 60% of its incoming invoices from abroad and, therefore, is especially suitable for researching the challenges in international electronic invoicing.

After this introduction, we present the diffusion of innovations framework and describe how it was used in this study. In the third section, we describe the methodology used in the paper. The fourth section presents the case company and illustrates the challenges in cross-border electronic invoicing. Finally, the conclusions are drawn in the fifth section.

Literature review and development of conceptual framework

The diffusion of innovations studies how, why, and at what rate new ideas and technology spread through organizations. The theory suggests a number of variables that determine the rate of adoption of an innovation. First, it identifies five factors or innovation characteristics impacting the adoption rate of innovations: relative advantage, compatibility, trialability, observability, and complexity. Second, it distinguishes between optional, collective, and authority innovation-decision types. Third, it discusses different channels through which the innovation is communicated. Fourth, it presents the nature of the social system as a factor affecting the rate of adoption. Finally, it acknowledges the extent of change agents' promotion efforts. (Rogers, 1995)

Since the early applications of the diffusion of innovations, the theory has been applied and adapted in numerous ways. In the information systems context, for example, the original five innovation

characteristics have been expanded to eight factors: voluntariness, relative advantage, compatibility, image, ease of use, result demonstrability, visibility, and trialability (Moore and Benbasat, 1991).

Alternative diffusion theories have also discussed, e.g., the inter firm and intra firm diffusion – the latter referring to the rate at which a particular firm, once it has begun to use a new technology, proceeds to substitute it for older methods (Mansfield, 1963). The intra firm process of technology transfer is a long one, with the new and old technologies co-existing for a long time (Battisti and Stoneman, 2005). Technological diffusion has also been explained through rank (such as firm size), stock (marginal adopter), order (high order vs. low order adopters) and epidemic effects (Karshenas and Stoneman, 1993).

In our study, we use the original framework by Rogers (1995) and apply it to the context of international, cross-border electronic invoicing. The following figure (Figure 1) depicts our conceptual research framework.

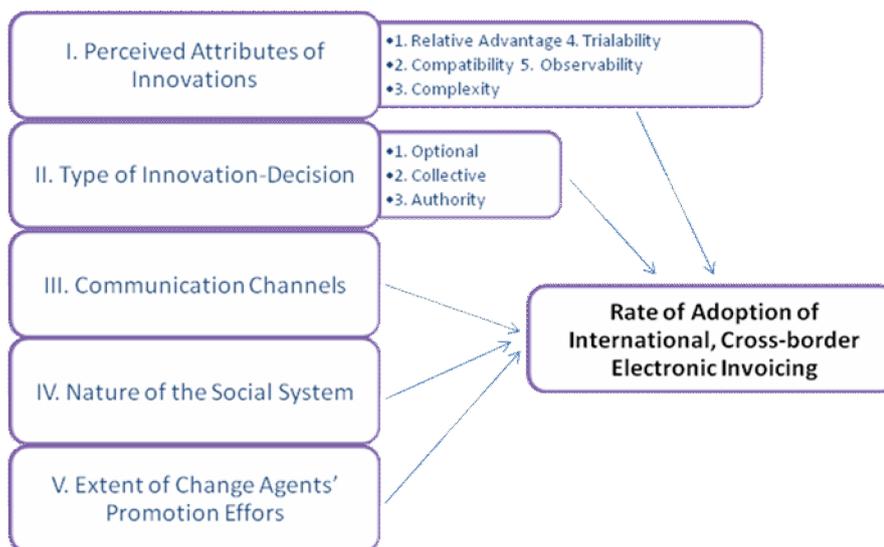


Figure 1. The conceptual framework for the study

Concerning the perceived attributes of innovations, relative advantage is the degree to which an innovation is perceived as better than the idea it supersedes (Rogers, 1995). When measuring the relative advantage of an innovation, it is not necessary to evaluate whether it has objective advantage over the precedent

idea. It matters whether an individual perceives the innovation as advantageous. The theory suggests that the greater the perceived relative advantage of an innovation, the more rapid its rate of adoption will be.

Compatibility is the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters (Rogers, 1995). Technical compatibility refers to the level of compatibility between the task being conducted and the technology being used (Cooper and Zmud, 1990; Tornatzky and Klein, 1982). In the case of electronic invoicing, this implies that electronic invoicing implementation success will be more likely to occur when invoicing characteristics are compatible with the technology characteristics (electronic invoicing solutions).

Complexity is the degree to which an innovation is perceived as difficult to understand and use (Rogers, 1995). Technical complexity refers to the level of task complexity related to the innovation. Prior research has shown that there is a negative relationship between the complexity of a technology and its successful implementation (Cooper and Zmud, 1990). In the case of electronic invoicing, a higher level of task complexity in electronic invoicing application suggests inhibited success of the implementation process.

Trialability is the degree to which an innovation may be experimented with on a limited basis (Rogers, 1995). The theory suggests that innovations that can be experimented with, in general, be adopted more quickly than innovations that are not trialable. This is due to the decreased uncertainty gained by experimenting.

Observability is the degree to which the results of an innovation are visible to others (Rogers, 1995). This observability stimulates discussion surrounding the innovation as the peer group requests evaluation information about the innovation. The theory suggests that the easier it is for individuals to see the results of an innovation, the more likely they are to adopt it.

Concerning the types of innovation-decision, optional innovation-decisions are choices to adopt or reject an innovation that are made by an individual independent of the decisions by other members of a system. Collective innovation-decisions are the ones made by consensus among the members of a system. Authority innovation-decisions are made by a relatively few individuals in a system who possess power, high social status, or technical expertise. (Rogers 1995)

Communication channels are categorized roughly in mass media and interpersonal channels. Rogers (1995) posits that mass media channels are relatively more important at the knowledge stage, and interpersonal channels are relatively more important at the persuasion stage in the innovation-decision process.

Concerning the nature of the social system and change agents, persuading opinion leaders is the easiest way to stimulate positive attitudes toward an innovation. The nature of the social system informs on the

types of opinion leaders that change agents should target. According to Rogers (1995), social systems can be characterized as heterophilous or homophilous. Heterophilous social systems tend to encourage change. There is more interaction between people from different backgrounds, indicating a greater interest in being exposed to new ideas. These systems have opinion leadership that is more innovative because these systems are desirous of innovation. Homophilous social systems, on the other hand, tend toward system norms. Most interaction within them is between people from similar backgrounds. People and ideas that differ from the norm are seen as strange and undesirable. These systems have opinion leadership that is not very innovative because these systems are averse to innovation.

In our study, we use the mechanisms described above to study the challenges in adopting international, cross-border electronic invoicing.

Methodology

In our study, we use the case study methodology to examine the challenges related to the implementation of international electronic invoicing. The case study methodology has distinct advantage when a "how" or "why" question is being asked about a contemporary set of events, over which the investigator has little or no control (Yin, 1994). In our research, we investigate how electronic invoicing is being adopted and what are the challenges the case company perceives as important in the process.

Furthermore, the strength of the case study approach is that it enables the capture of "reality" in considerably greater detail and the analysis of a considerably greater number of variables than is possible with many other approaches (Galliers, 1991). This was especially important in our work as the objective of this research was to find the underlying factors and challenges for moving to international electronic invoicing, and not just the company policy statements.

To be included in this paper, we selected the case company Finnair. The case company is especially suitable for this kind of research as it receives around 60% of its incoming invoices from abroad. The company is also very keen on promoting electronic invoicing and wants to increase the level of its incoming electronic invoicing, both domestically and internationally.

Our case research included discussions and interviews with the key-informants of the researched company. In addition, we conducted an extensive review of company documents such as annual reports and marketing brochures. More specifically, the case Finnair is based on interviews held at the Finnair financial services center with discussions with the CEO, the development director, and two managers of the financial services center.

All the interviews focused on invoicing issues. We started by letting the informants describe the incoming and outgoing invoices; volumes, types of senders and receivers etc. We then proceeded to asking more specific questions regarding the implementation of electronic invoicing: the motives and the challenges, especially in the case of international electronic invoices.

Case study Finnair

Finnair was established in 1923 and is one of the world's oldest operating airlines. Its operations focus on transporting passengers between Europe and Asia, via Helsinki. Finnair Group operations cover scheduled passenger traffic and leisure traffic, technical and ground handling operations, catering, travel agencies as well as travel information and reservation services. The number of personnel of Finnair Group is approximately 9,500. The subsidiaries provide air traffic support services or operate in closely related areas. Finnair's major shareholder is the Finnish government with a 55.8 per cent holding. Other shareholders include insurance companies, various companies and private individuals. Approximately 20 per cent of the shares are owned by foreign shareholders. The Finnair fleet comprises more than 60 aircraft. During the calendar year 2008 Finnair carried a total of 8,270,100 passengers. A total of 6,950,700 passengers were carried on scheduled passenger traffic routes and 1,470,600 on domestic routes. The number of passengers on leisure flights was 1,319,400. Cargo and mail carried by Finnair in the year 2008 totalled 102,144 tonnes. (source Finnair website www.finnair.fi)

Handling Incoming Invoices at Finnair

The Finnair financial services center received 173,397 invoices in 2008 (excluding Finnair catering, FinnCatering and SMT and Area travel agencies). Domestic invoices represented 40% of the volume, international invoices 60%. Concerning electronic invoices, roughly 30% of domestic invoices arrived in electronic format. Only a few international suppliers provided the invoice in electronic format (JFK, Heathrow, and Statoil). The Finnair financial services center employ 84 people of whom 24 are directly involved in invoice handling.

With very few exceptions, all incoming paper invoices are received in Finland. The 24 people involved in invoice handling at the financial center open the envelopes, scan the paper invoices into electronic format, fill in the basic information and sends the invoices electronically to accounting and approval. Finnair uses the Basware Invoice Processing (IP) system. The exceptions that make the rule include, e.g., Japan, Thailand, Russia and China. Invoices coming from these countries are sent to the local country office where the invoice is scanned and inserted into the electronic system on site.

Concerning the international electronic invoices, IATA (International Air Transport Association), has created an add-on service through which airline suppliers can send electronic invoices. Finnair receives invoices from JFK airport security services in New York, Heathrow airport in London, and Statoil in Norway through this system. The objective of Finnair is to get as much as possible of the international invoices into electronic format. In domestic invoices, the objective is set at 50% of all incoming domestic invoices by the end of 2009.

1 Perceived attributes of innovations

The five perceived attributes of innovations affecting the rate of adoption of an innovation were relative advantage, compatibility, complexity, trialability, and observability. We next report the findings of the interviews related to these five factors.

Relative advantage

The relative advantage of an incoming electronic invoice, compared to a paper invoice, was three-fold. First, the respondents mentioned the cost factor. They had estimated that handling an incoming paper invoice generates costs of 45 euros per invoice. These costs are incurred by the fetching and opening and envelope, scanning costs, manual feeding of information, maintenance, approval, accounting, and information systems. By moving to electronic invoicing, these costs can be lowered to 10 euros per invoice. The electronic invoice essentially removes the phases related to manual handling of invoices, scanning, and also possibly approval and accounting as these functions can be automated by electronic invoicing to some extent (provided that the relevant accounting information is transferred in the electronic invoice data).

Second, the respondents mentioned speed. As an example, when the JFK airport in New York sends the electronic invoice to Finnair, it arrives at Finnair in 15 minutes. Compared to the paper-based version that would be sent to the Finnair New York office, then through airfreight to Finnair Helsinki-Vantaa office in Finland. Then the paper invoice would have to be manually processed and scanned at Finnair, resulting at least in a 5-6 days delay. By getting the invoice in electronic format, Finnair is also able to provide a much more accurate cash management and cash forecasts. An electronic invoice is included directly in cash management whereas it takes at least a week for a paper invoice to be visible in the system.

Third, the respondents stated the number of errors as an advantage of the electronic invoice. The removal of manual steps in the process naturally decreases the number of errors. In addition, the electronic system has an automated error tracking system which picks out the invoices that have some nonconformities in them. The electronic system also allows the invoices to be handled in different languages, lowering the possibility of confusion in invoice handling.

Compatibility and complexity

When asked about the compatibility of the electronic invoice handling system to past and current work practices, the respondents noted that the invoice processing system performed surprisingly well. The system requires rather much capacity from the computer so a powerful server is required. The system also makes its user to perform tasks in correct manner and in case of an error, it points the user to the source of the error. The respondents were of the opinion that the technology is already there, now it is only a question of getting the routines adopted in every country organization.

Concerning the complexity of the electronic invoicing system, the respondents mentioned the scattered landscape of the, e.g., British invoice operator market. There are a number of operators using different kinds of standards for invoice data transfer and the respondents felt that these operators are not connected and communicating with each other. The operator that Finnair is using is required to make contracts with each of these operators. Once this has been done, everything has been running smoothly.

Trialability

On a general level, the respondents felt that piloting the electronic invoice with a supplier was very important. Sometimes there problems with the initial, first invoices that are being sent electronically between the supplier of Finnair. Tackling these problems immediately through using piloting invoices was seen very important. The respondents also felt that an acknowledgement system similar to e-mail systems would be beneficial. In this system, the receiver would notify the supplier that the electronic invoice has been well received.

Observability

Two years ago, the penetration levels of electronic invoicing were not measured and or communicated within Finnair. Today, there are clear objectives and regular reporting from the Finnair financial services to the headquarters concerning the levels of electronic invoicing. This has helped the company a lot in increasing the importance of electronic invoicing internally within Finnair.

II Type of innovation-decision

Adopting electronic invoicing practices at the supplier site is naturally an optional innovation-decision for the supplier. However, there are organizations that have made firm requests to their suppliers to provide them with electronic invoices. In Finland, there are a number of organizations (both private and public) that demand the invoices to be sent in electronic format. Finnair is joining this frontier during Fall 2009 with a letter to their domestic suppliers indicating that all invoices should be sent in electronic format in order for the business relationship to continue. In this sense, the innovation-decision at the supplier site can be seen

as an authority type. In the case of international cross-border electronic invoicing, these demands are somewhat difficult to make as there are no universal standards to sending electronic invoices (see below change agents' role for further discussion on this topic).

III Communication channel

Concerning the communication channels for distributing information on electronic invoicing, the business-to-business electronic invoicing mainly relies on interpersonal communication. Finnair is very actively contacting their suppliers to advance the level of electronic invoicing. Finnair has noted that it is very important to communicate to their suppliers the possibility of sending invoices in electronic format. In addition, they see it very important to discuss the method of sending invoices when they sign the contract or renew the contract with a supplier. Usually, they cite the electronic invoice as a first choice, then pdf-file as an e-mail attachment as a second choice, the last choice being the paper-based invoice.

Exceptions to this mainly interpersonal communication include seminar presentations and mass marketing letters to the suppliers. Finnair is actively participating to supplier seminars and business conferences in the field of financial administration, promoting the use of electronic invoicing. In addition, Finnair actively promotes electronic invoicing within the company in internal training seminars.

IV nature of the social system

Concerning the nature of the social system, its norms and degree of interconnectedness, the respondents mentioned that there are countries that have certain legislation issues that hinder the advancements of electronic invoicing. As an example, in order to get the VAT refund in Hungary or Poland, the company is obliged to send the physical invoices to the local tax office. In Indonesia, the CFO of the supplier company is obliged to sign every outgoing invoice manually, thus keeping the hierarchy very strict. Yet, as another example, in Germany, all invoices have to have a signature according to the German legislation. These are all examples of how the nature of the local social system affects the adoption of cross-border electronic invoicing.

V Extent of change agents' promotion efforts

The Rogers (1995) framework cites the extent of change agents' promotion efforts as the last determinant of the rate of adoption of an innovation. We asked the respondents of the case company to enumerate the change agents operating in the field of international cross-border electronic invoicing. The respondents mentioned the European Commission, industry unions, the federation of entrepreneurs, the federation of financial administration firms, and enterprise resource planning (ERP) system providers such as SAP.

The respondents especially acknowledged the work by the European Commission expert group on electronic invoicing. The task of the expert group, headed by Bo Harald, is to (1) remove the obstacles concerning international electronic invoicing, (2) create standards, and (3) establish a network to ensure a fruitful basis for cross-border electronic invoicing. Concerning the first objective, the expert group has advised that the digital signature requirement in use in some European countries should be removed. In order to create a common standard, the expert group is working together with UNCEFACT and SWIFT to create a cross-industry invoice standard (CII). To establish a network, the expert group is promoting the creation of a service provider association (SPA) to tackle the complexities and technical problems related to the conversion from standard to standard.

Discussion and Conclusions

In this paper, we set out to explore the challenges in international, cross-border electronic invoicing. We applied the innovation diffusion framework by Rogers (1995) and conducted a single-case study at Finnair. Our findings indicate that the challenges in implementing international electronic invoicing cannot be explained through the perceived attributes of the innovation. All the five characteristics (relative advantage, compatibility, complexity, trialability, and observability) point to a rapid adoption of international electronic invoicing, however this has not been the case. Our findings from this single-case study highlight the importance of the extent of change agents' promotion efforts and nature of the social system. Governmental organizations are in a key position to create the means and take down the barriers related to cross-border electronic invoicing.

As a main limitation of this study, we acknowledge that it reports the findings from a single-case study. We are currently conducting several case studies to get further data and observations to this research problem. Nevertheless, we consider Finnair as a prime case company for researching the challenges related to international electronic invoicing for two reasons. First, the company receives more than half of its incoming invoices from abroad. Second, the company is eager to promote electronic invoicing and have created measurement techniques to measure the penetration of electronic invoicing.

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