Effects of e-business between public and private sector based on the simulation of implementing e-Invoice

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Abstract: *In this paper we research positive and negative aspects of the application of e-business related with the introduction of e-invoice as the basic method of payment. With the application of simulation tools IBM WebSphere Business Modeler, the simulation models of the existing payment processes (the classic invoice) and future e–model payment (e-invoice) were made. After having defined all the elements of these models with belonging costs per unit of time, the simulation study of the invoice exchange between the private sector and public sector was conducted. The aim of this simulation is the comparison of the existing model with the future electronic payment model. Limitations were observed related to the feasibility and justified introduction of the e-invoice for subjects who have relatively low annual volume of payment / invoice. Also, problems related to interoperability, security and archiving e–invoice are briefly discussed and proposed as important factors for future research*

Keywords*: e-business, e-invoice, business process simulation, model assessment, adoption*

1 Introduction

Nowadays, companies are faced with requirements related to flexibility, assuring quality, reducing their own costs, integration and conquering new markets.

Introducing information and communication technology (ICT) companies want to increase the effectiveness of their business system.

Over the last 15 years ICT has had an intensive development and implementation, especially the Internet which has significantly influenced the development of e-business.

E-business [5] can be defined as a set of activities undertaken by the participants to exchange goods, services and information using ICT.

Croatia has strategic plans [11] to introduce e-business, and one of the national projects is the e-invoice.

According to European Commision [3] e-invoice is the electronic transfer of invoice information (billing and payment) between business partners (supplier and buyer), whereas according to [5] this term implies an invoice generated and exchanged based on XML (extensible Markup language) without paper at any stage.

The reason for introducing e-invoice [11], [2], [3], [4], [15] can be seen in the potential fiscal contribution (improve cash flow), cost savings by reducing invoice processing cost, the desire to achieve new values, links the internal processes of the company to the payment systems, increasing the competitiveness of EU enterprises, increased customer satisfaction, the dematerialization of invoices, as well as creating a Single Euro Payment Area at the EU level.

A very important driver for implementing the electronic process (e-inovice), for EU Expert Group [4] is the public sector.

European Banking Association (EBA) [2] says that the use of e-invoice in a country is associated with the economic growth.

The aim of this study is to critically consider what are the positive and negative effects of the application of e-invoice as part of e-business, and to appreciate the impact of its implementation on costs.

2 Theoretical framework

A invoice is the result of business practices and is associated with the process of trading (trade). It has significance for the seller (the foundation for getting money), the customer (certificate of purchase) and the State (tax calculation).

At the European level there are various initiatives to introduce e-invoice: NemHandel (Denmark), pan-European public procurment online (PEPPOL), e-PRIOR (pilot project of the European Commission - EC), the Single Euro Payments Area (SEPA) and the EC formed the Expert Group to establish the European Electronic Invoicing Framework.

Each invoice according to [2,17] must meet two basic requirements, namely: operational (the link between order and delivery of goods / service and the related Payments) and legal (taxation, the right to privacy).

The form and invoicing itself are legally and normatively defined.

In Croatia, the invoice and the procedures for issuing and archiving are defined within the Law on Value Added Tax (National Gazzetta (NG) 47/1995, with amendments) and Accounting Law (NG 107/07). The Electronic Document Act (NG 105/2005), the Law on Electronic Signatures (NG 10/2002, NG 80/2008) and the Electronic Commerce Act (NG 173/2003, NG 67/2008, NG 36/2009) are applied to the e-invoice.

With the Electronic Document Act (NG 105/2005), the electronic document and the document in paper form are legally equalized, and issuing and using, archiving and protection are determined. Further protection procedures are determined through the legal regulations related to information security and data protection (e.g. the Law on Information Security, the Law on Data Secrecy).

Within EU e-invoice is covered by EU directives: 2001/115/EC, 2006/112/EC. The EU has agreed to consider the proposal of changes (and COM/2009/21 COM/2009/22) of Directive 2006/112/EC in order to use e-invoice in a better way (the omission of electronic signature) and to prevent fraud.

The Expert Group [4,31] is committed to involve 11 core principles of the Code of Practice in the implementation of e-invoce (Equality of treatment, Technology neutrality, Business controls, Mutual Recognition, Auditability, Readability, Maximum choice, Proportionality, Use of service and solution providers, Public and private sector, Legal harmonization and simplification).

2.1   Data Exchange Model

Since e-invoice includes the exchange of data within a country, over cross-border, with different technology systems and application, it is necessary to provide the infrastructure which will ensure the correct data exchange among participants, in order to apply e-invoice. The infrastructure must allow [14]:
- existence of common interoperability framework
- standardized format for message and
- secure message transport.

Peristera at al. [12,614] claim that interoperability is recognized as the key factor for the function of the public sector.

Within the European Interoperability Framewok [9], interoperability is defined as the ability of ICT systems and of the business process they support to exchange data and to enable the sharing of information and knowledge.

According to [9] there are three different levels of interoperability: organisational interoperability, semantic interoperability and tehnical interoperability.

Considering the level of ICT application these are the forms of exchanging the invoice and the e-invoice [1,7]: manual invoicing process, semi-automated invoicing process using traditional pdf invoicies, semi-automated invoicing process using sender based web invoices, semi-automated invoicing process using receiver based web invoices and fully automated e-invoicing process.

The models of exchanging e-invoice between companies, according to [4], are the following:
- Bilateralal - without intermediaries, they are responsible for interoperability, invoices are sent by email as pdf, downloaded from the Web or in digital records, archiving is a local.

- Three-Corner – with one common service provider (Sp), which ensures the interoperability, data exchange and archiving.
- Four-Corner – each part has its own Sp, which can exchange data through other intermediaries.
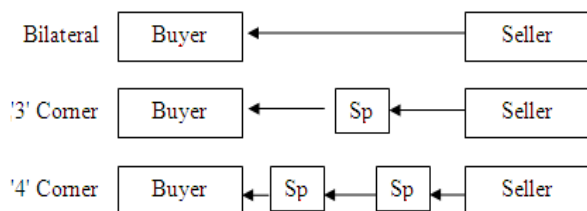

Figure 1. *Model of data exchange (source: Final Report oft the Expert Group on e-Invocing, p. 79)*

2.2   Costs and benefits

Cicirieloo and Haywort [1,1] state that according to Aberdeen Group research, paper invoice costs between 1.13€ and 1.65€. E-invoicing would reduce cost per e-invoice to between 0.28€ and 0.47€, a reduction of 70% to 75%, and the European Associations of Corporate Treasures estimates that the company can save approximately 80% if it has an electronic invoice.

The Expert Group [4] states that the recipient of e-invoice has bigger savings than the sender. They also present data on the possible savings (adaption of e-invocing could result in staff cost savings alone of 5 – 15€ per invoice; full cost for processing traditional paper based invoices are quite often as much as 20€ per invoice).

Wallis [15] gives the following estimation of the amount of costs associated with the traditional paper invoice and sending mail, by post: 0.95$ to 1.25$ per transaction (research by Xenos Group of Richmond Hill), from 1$ to 3$ (research by Credit Research Foundation). For the costs of e-invoice he lists data from the research by Gartner Group of Stamford, which give an estimated cost of about 0.25$ and 0.30$.

However, it is not clear from the research how many invoices were taken into account, for which size of companies, which levels are involved in processing the invoice. In [4] it is not clear which data (research) the authors used to come to these amounts.

The positive sides of using e-inovice can be seen, according to [1], in opportunity (or competitive advantage) to have access to a wider market of potential customers and suppliers (access to large companies) and to enable companies' growth in relation to orders, buyers, suppliers.

Members of Expert Group [4] see advantage of using e-invoice in: dematerialization of invoice (avoiding manual work, e.g. entering data, interventions...), the use of structured e-invoice within the whole supply chain, customer retention (fulfilling the expectations of trading parties), quality improvement (through direct communication and elimination of errors caused by manual handling), efficiency gains (through optimized and automated processes, better transparency of working capital movements and faster payment of invoices).

2.3   Adoption

The application of e-invoice requires the highest level of implementation and use of ICT. The main problems with introducing e-invoice, according to [1] are: rediness / compability with internal information systems, legal uncertainty, customer readiness / compability, complexity.

Research by Politecnico di Milano [13] shows that there are several problems (barriers): external (complicated and internationally non-homogeneous legislative framework and absence shared standard) and internal (management's insufficient knowledge, resistance to managment by process and stronger resistence to supply chain colloboration).

Wallis sees the following problems int he use [15]: integration in the existing ERP systems and processes, the lack of standard, this technology is fairly new and has not been fully developed, high price of these systems.

EBA[2,19] states that there are reasons why paper invoice should be used: contractual, authority and capacity, record keeping, fear or fraud and security.

According to data issued by the Croatian Chamber of Commerce [8] for year 2008, there were 89.686 enterprises in Croatia, 87.807 (97,9%) of which were small and medium enterprises.

Research by Fathian et al.[6], Harindranath et al.[7] and Kotelnikov[10], small and medium enterprises have a problem in the application of ICT, the reasons are poor infrastructure, high costs, low ICT literacy of owners and employees, the problem with funding and selecting the

correct hardware and software, and most existing products are adapted to large enterprises.

The Indicator Networked Readiness Index (NRI) for year 2009 shows that Croatian enterprises have [16]: low level position for technology absorption (102 position) and extent of staff training (107 position). The infrastructure indicators for NRI are on higher level, e.g. import of computer, communication (11 position), Internet bandwidth (19 position).

These indicators point to possible problems in the implementation and application of e-invoice as well as in exploiting the full potential of ICT technology in Croatia.

3 Methodology

Methods of interview and simulation are applied in this paper.

Data collection was done on an accidental sample. Following companies were taken as the sample: University of Zadar (Public Sector - P), Reem electronic Ltd. (private sector - B1) and Adriatic Security Ltd. (private sector - B2). This sample was taken for the following reasons: a) in these companies there is an exchange of bills between the private and public sector, b) permits identifying the whole process associated with the exchange of invoice and e-invoice and c) companies approved the use and disclosure of data in this paper.

The interview was conducted during April 2010 with a member of the management and head of accounting based on predefined check list. Thus the data were collected related to the processing of bills: total number of incoming and outgoing invoices, account activity for treatment, estimation of duration of activities, resources that are related to the operation and related costs the resource, supporting the activities by ICT and the way of archiving documents.

Based on the collected data and models of exchanging data through the service provider (Figure 2.), a conceptual model of the existing exchange of paper based invoice (As-Is) for the relations between the enterprises was made.

The activity of correcting errors is ignored in the design of the conceptual model. This omission is possible because, based on their business practice, it was found that they occur very rarely so that time which is spent on such situations in these cases is irrelevant to the duration of other activities in the process.
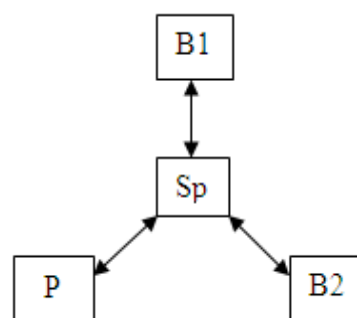

Figure 2. *Data exchange over one service provider*

When calculating the cost for the As-Is model (issuing and receipt of invoice), according to [1], we took the following into account for the seller: activity cost (processing and archiving), cost of resource (pc, people), cost of printing paper, postage and handling, and in the customer activity cost (processing and archiving), cost of resource (pc, people). Activities take place in sequence to get the longest critical path. Since it is possible to predict exactly what will happen with the model and the activities, the deterministic model will be used.

The conceptual model of e-invoice (To-Be) was made according to the model of data exchange (shown in Figure 3) and the general conceptual model of e-invoice (shown in Figure 4). In the general conceptual model of e-invoice, when considering the seller, we took the actions related to the generation of invoice, activities related to joining the signature and time stamp, electronic archiving, transmission through the Sp and confirmation of receipt of e-invoice. When considering the buyer we took the following into account: verification of e-invoice and booking within the system

(link to procurement; finance, accounting) authorization for paymnet and electronic archive.
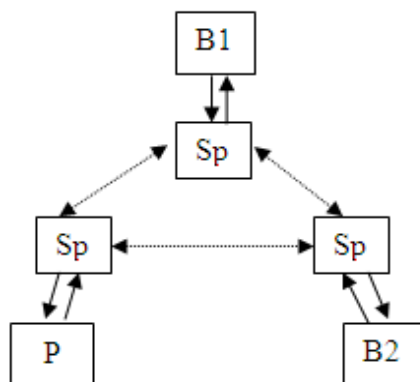

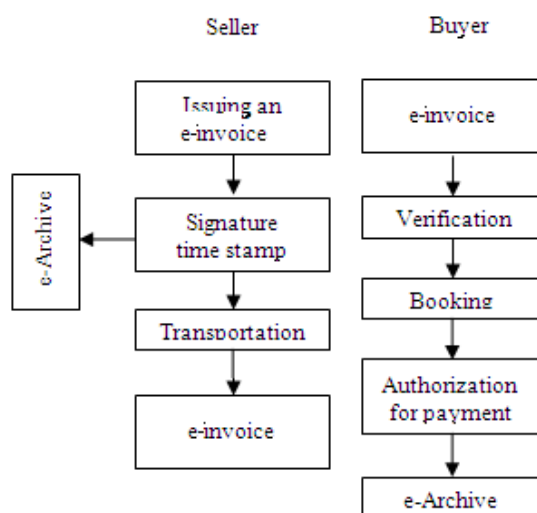**Figure 3.** *Data exchange over several service provider*

Figure 4. *Conceptual Model e-Invoice processing*

In the To-Be model e-invoice is in digital form. All activities can receive and process it. There is no need to print the invoice on paper. Data archiving is local.

In the To-Be, according to [13,16], lowering costs in e-invoicing in relation to invoice can be done by eliminating low value added activities (e.g. manual data entry from paper, correction of different errors in the entry). We excluded activities from the To-Be which can be done by ICT (e.g. physical dana transfer).

Considering the complexity of the process and activities, Zelenika et al. [17] state that the

adequate method for such research and modelling is the method of simulation.

The simulation of costs of both models is based on the Activity Cost Based methodology, which was applied in the research [13] for e-invoice by the School of Management, Politecnico di Milano.

Simulation models As-Is, To-Be and the simulation of calculating the costs were made with the software package IBM WebSphere Business Modeler Advanced 6.1.2.

4 Results and discussion

University of Zadar (P) was founded in 2003. Its core business activity is education and research. There are 504 employees, and in the year 2009 it had 2850 incoming and 4950 outgoing invoices. It is not in the system of value added tax. The company has a business information system that was purchased.

Reem electronic d.o.o. (B1) was established in 1995. The primary business is selling ICT equipment and services. It has 10 employees and the total of 3102 incoming and 4080 outgoing invoices for year 2009. The company has a business information system that was purchased.

Adriatic security d.o.o. (B2) was founden in 1969. Its primary activity is the provision of physical and tehnical protection, transportation of cash and securities. There are 527 employees. In 2009 tehre were 3752 incoming and 4427 outgoing invoices. The company has a business information system that was purchased.

All employees who work with incoming or outgoing invoices have a PC.

Based on the reasearch [13,71] company administrative activity of these companies falls within the group low according to the number of invoices.

Regarding the use of ICT there are models of exchange: Manuel Invoicing (P to B1, B2 to B, and B1 to B2), and semi-automated process using traditional invoicing pdf invocies (B1 to P). Based on the collected data and the simulations we made, the costs and time needed for

processing for As-Is and To-Be were obtained, as shown in Table 1.

Table 1.: *Cost and time of invoice and eInvoice processing*

	Inovice (paper based)			
	Cost in € / ProcessingTime			
	In	t (min)	Out	t (min)
P	5,29	51	1,4	11
B1	2,46	23	1,6	9
B2	3,72	30	2,4	14
	e-invoice			
	Cost in € / Processing Time			
	In	t (min)	Out	t (min)
P	3,47	26	0,9	8
B1	1,00	10	1,1	6
B2	1,32	11	1,4	10

Comparing As-Is and To-Be it is evident that the process e-invoice would reduce costs and processing time within a single company.

We reduced the cost of invoice processing, but this does not mean that we reduced the costs at the level of the company (e.g. employees who work with invoices are still employed within the company). Since time to conduct the activities has also been reduced, resources (people) are no longer needed for these activities, which means their availability has increased.

We found the following exchange of invoices within paper based invoice B1 (seller) - P (Buyer), B2 (seller) - P (Buyer) and B1 (seller) - B2 (Buyer).

The costs of data exchange from the activity of generating invoice up to the movment of generating orders for payment between private and public sector as well as private to private for invoice and and e-invoice are given in Table 2.

Table 2.: *Cost of data exchange (in euro)*

Relation	Invoice	e-invoice
B1 to P	6,89	4,57
B2 to P	7,69	4,87
B1 to B2	5,32	2,42

The data show that the costs of exchange with public are higher. These costs are higher due to the process and the necessary

approvals in the processing incoming invoices. Using e-invoice this process can be accelerated, which would result in better productivity of enterprises.

Invoice archiving in these companies is technologically very simple and is done with archiving registers. In this way, companies do not have access to all information related to incoming or outgoing invoices, and a longer period of time related to the search is required.

Moving to a digital archive of e-invoice companies would accelerate their archiving activity as well as data search. Archiving according to the Law on Electronic Document (Article 20), has not been established within these companies and requires additional investments or paying for services.

Positive effects of applying e-invoice on the example of these companies can be seen in: the possibility of moving activity from low added value, speeding up processing which can affect the positive cash flow, easier search and data accessability, accelerating the documentation, minimized possibility of errors in data entry , a notice of receiving the invoice by the other side.

The negative effects of the application can be seen in necessary adjustment of information systems, additional investments, the procedures become more technologically demanding,   new types of costs are generated, archiving is technologically more demanding, problem in closing the e-invoice without e-bidding.

5 Concluding remarks

Based on this study (with the existing restrictions regarding the choice of suitable sample) it is obvious that using e-invoice will bring to reducing costs related to proccesing invoices, and provide increased availability of resources.

Considering the above mentioned there are preconditions to include free resources into activities that could create new business values for the organization.

In this sense, further research should be conducted regarding the definition of these activities, scope and possibilities of joining the resources into those activities, as well as the effect on the overall business that would follow from this approach.

Using e-invoice (incoming) public enterprises have the possibility to cut costs and speed up processing time, and thus influence their own productivity.

The basic efefcts of using e-invoice can be seen in the faster processing, searching data and their accessability

Negative sides of using e-invoice relate to necessary adjustments of the information system, the problem in closing the e-invoice without e-orders and technologically more demanding operating procedures

A special emphasis in future research should be put on other forms of e-business (e-catalogue, e-procurement) in order to get insight into its positive and negative sides and possible adoption.

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