

WHY ARE ELECTRONIC INVOICE PROCESSES RISKY?- EMPIRICAL ANALYSIS AND DISCUSSION OF RISK FACTORS

Complete Research

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Abstract

Electronic invoice processes are characterized by various software solutions, legal uncertainty, heterogeneous demands, lack of know how, and information system infrastructure incompatibilities. Due to this complexity and the uncertainty that companies face, a holistic map of risk factors of e-invoice processes is required. Companies must be conscious not only about potential opportunities but also about potential risks before they change their business processes and their information systems' architecture. Potential risk factors are identified theoretically and empirically evaluated with a quantitative expert survey that investigates risk probabilities and potential losses associated with these factors. The empirical analysis reveals that the investigated factors are valid and reliable. After conducting an explorative factor analysis, 37 statistically significant risk factors are grouped into ten risk dimensions: process organization, standard, environment, project management, strategy, acceptance, system, process execution, security, and change management.

Keywords: e-invoice, electronic invoice processes, risk factors, risk probabilities

1 Introduction

Successful companies focus not only on their daily business, but also on their relationship with business partners and on their own business processes. The digitalization of business processes is an essential method for cutting down administrative costs, improving productivity in business processes, and achieving process transparency (EU Expert Group on e-Invoicing, 2009). As part of the Europe 2020 strategy the European Commission (EC) has the vision of an European social market economy that is highly competitive and takes full advantage of the benefits offered by digitalization (European Commission, 2010). In order to improve efficiency and provide competitive advantages, it is crucial to use information systems (IS) to support both internal business processes and processes with business partners (Sandberg et al., 2009; Tanner et al., 2008). Especially a fully integrated procure-to-pay process chain provides essential cost savings (EU Expert Group on e-Invoicing, 2009) as well as an automation of the accounting processes (Kivijäri et al., 2012). In order to achieve these benefits, business partners need to exchange their business documents electronically. A pivotal business document is the invoice. Invoices bear commercial and legal consequences for companies. No business can operate without invoicing. The invoice, including self-bills issued by the receiving company, is the core ele-

ment of the European system of value added tax. According to Council Directive 2010/45/EU, companies are only entitled to pre-tax deductions based on an invoice. The use of electronic invoices (e-invoices) reduces the total cost compared with paper-based invoices, and improves the efficiency of business processes “through eliminating manual data entries, automatically matching purchase orders to invoices, invoice reconciliation and account assignment” (Legner and Wende, 2006). Electronic exchange of invoices is expected to generate significant economic benefits, especially if the e-invoice provides structured data for automated processing (Kivijäri et al., 2012). Since the 1970s, companies have used electronic data interchange (EDI) to optimize their processes with business partners (Kabak and Dogac, 2010; Penttinen et al., 2008). Business documents like orders and invoices are exchanged automatically using standardized procedures. The benefits of EDI are cost and time savings because there is no manual data entry, which in turn prevents redundant and incorrect data input, requires less administrative overhead, and makes data immediate and universally available (Beck et al., 2002). But many different document types exist, including industry-specific and proprietary standards (Kabak and Dogac, 2010). Therefore, business partners have to agree on a common standard for data syntax and semantics of the content of the documents. The implementation costs are high (Beck et al., 2002): they include not only costs for software and hardware, but also for redesigning the companies’ processes. EDI is not profitable for all companies due to its high level of complexity, uncertainty about the appropriate standard, high implementation and operating costs, lack of know-how, and too few business transactions. Current standards and developments enable interoperability between IS from companies of any size (Kreuzer et al., 2014).

E-invoices promise savings of both cost and time, because they reduce manual work, input errors, printing, and transport costs (EU Expert Group on e-Invoicing, 2009; European Commission, 2010; Kivijäri et al., 2012; Sandberg et al., 2009). Workflows, process transparency and traceability are improved by processing e-invoices (Haag et al., 2013). Administrative tasks are reduced and efficiency is enhanced by deploying human resources to more productive tasks (Hernández-Ortega, 2012). E-invoice processes have “evolved from being an office tool to becoming an organizational resource for business strategy” (Hernández-Ortega, 2012). It is a strategic decision to participate in exchange of e-invoices and consequently in e-invoice processes. This topic is also a focus of European legislation. The EC states that “(i)t is vital to create an environment that enables a maximum number of trading parties to exchange invoices to ensure the mass uptake of e-invoicing” (European Commission, 2010). To promote electronic invoicing (e-invoicing), an European standard for the public procurement in the European Union (EU) will be established in order to reduce the “obstacles to cross-border trade deriving from the co-existence of several legal requirements and technical standards on electronic invoicing and from the lack of interoperability” (European Union, 2014). By the end of 2020 all public authorities in the EU have to accept e-invoices in this European standard (European Union, 2014).

Despite the obvious benefits, the market penetration of e-invoices in the EU is still low for business-to-business (B2B) transactions (European Commission, 2010; Hernandez-Ortega et al., 2014). In the EU about 29% of companies with at least 10 employees are sending or receiving at least one structured e-invoice (Eurostat, 2014). Challenges for participation in e-invoice processes are a lack of awareness and a lack of adequate IS for process optimization (Haag et al., 2013), as well as high investment costs and heterogeneous demands of the business partners (Tanner et al., 2008). The EC recommends that business partners and service providers find solutions for interconnected e-invoice processes (European Commission, 2010). In addition to agreements and standards for automated invoice exchange, the EC is also calling for risk management. With the lack of interoperable e-invoice solutions, there is a risk that companies need to invest in a number of solutions, causing unnecessary expenses (European Commission, 2010). Another risk is being dependent on a service provider that generated switching costs by customizing the service being used (Penttinen et al., 2008). According to Hernández-Ortega (2012), companies “with a strong fear of the unknown will perceive less risk if they consider that e-invoicing is compatible with their business activities”. However, each company faces uncertainty and has to decide how much uncertainty they are willing to accept. In order to improve

their efficiency and provide competitive advantages, companies need to be aware of potential opportunities and risks of e-invoice processes before they decide to change both their business processes and their IS architecture. The purpose of this research is to identify the potential risk factors and to appropriately organize them for risk assessment of e-invoice processes. Consequently, the following research questions are addressed:

RQ1: What are the critical risk factors associated with e-invoice processes?

RQ2: How can these factors be grouped from a risk management perspective?

Prior research on e-invoice processes does not focus specifically on risk factors but can be used to identify potential risk factors. Research mostly concentrates on the identification of critical success factors affecting the diffusion of the exchange of e-invoices (e.g. Arendsen and Wijngaert, 2011; Kreuzer et al., 2013; Penttinen and Hyytiäinen, 2008). The critical success factors mentioned by the analyzed literature on e-invoice processes are the basis for the developed risk factors.

First, the theoretical background of risk management for e-invoice processes is introduced. Then, the research methodology is explained. To answer RQ1 the potential critical risk factors of e-invoice processes are identified through a structured review of e-invoice literature. Their significance is empirically evaluated by a quantitative expert survey. Based on these results the critical risk factors are statistically grouped to answer RQ2. Subsequently, the empirical results are discussed and recommendations are derived. Finally, theoretical and practical implications, limitations, conclusions and an outlook on future research are presented.

2 Risk Management for E-Invoice Processes

The invoice links the business processes order, delivery, payment, and accounting. It is one of the most important documents exchanged between business partners, including public authorities. But the invoice is much more than a commercial document. It also has legal implications. In the EU, taxable companies have to ensure the authenticity of the origin (assurance of identity of the invoice issuer), the integrity of the content, and the legibility of the invoice from the point of creation until the end of the storage period in order to deduct pre-tax (European Union, 2010). This responsibility applies to both paper and electronic invoices and is obtained by “business controls” (European Union, 2010). These internal control mechanisms must guarantee “a reliable audit trail between an invoice and a supply of goods or services” (European Union, 2010). According to current law, the recipient has to agree to the exchange of e-invoices. Companies have to deal with various solutions and technologies for electronic invoicing and processing. They have to decide if they are ready to change their business processes and their IS architecture. This decision depends on expected benefits and potential risks.

The term risk is defined in various ways. According to Rommel and Gutierrez (2012) all of these definitions have in common, that “risk is concerned with the probability that something unfavorable will occur mostly followed by a loss”. Normally, risks are expected to have a negative outcome for the company, but there are also uncertain events with a positive outcome for companies. These risks are called opportunities (Kivijäri et al., 2012). Risks can be located inside the company (internal or unique risks) or beyond the control of a company (external or market risks) (Kivijäri et al., 2012; Rommel and Gutierrez, 2012). In order to be capable of deciding how much uncertainty they are willing to accept, companies need to know the potential risks. They evaluate how much impact each risk has on the achievement of the companies’ objectives. According to Boehm (1991), risk management consists of risk assessment and risk control. Although no standard process of risk management has emerged, the fundamentals of risk assessment are the same: risk identification, risk analysis, and risk evaluation (Boehm, 1991; Coyle and Conboy, 2009). The identification of risks is the initial step of efficient risk management (Ghadge et al., 2013). This step produces a list of risks that have a negative impact on the companies’ outcome. Then, the risk analysis “assesses the loss-probability and loss magnitude for each identified risk item, and it assesses compound risks in risk-item interactions” (Boehm, 1991). The

probability of risks measures the likelihood that an uncertain event will occur (Coyle and Conboy, 2009). The consequences of risk can be described through a qualitative (terms like ‘low’ and ‘high’) or a quantitative (e.g., monetary units) analysis (Coyle and Conboy, 2009). Finally, the risks items are prioritized (Boehm, 1991) and evaluated (Coyle and Conboy, 2009) in order to decide which risks must be avoided and which risks can be accepted (Rommel and Gutierrez, 2012). According to Boehm (1991) a risk-exposure analysis is the most effective technique to evaluate risks because it ranks the risks that are “most important to address.” The risk exposure is the product of “the probability of an unsatisfactory outcome” and “the loss to the parties affected if the outcome is unsatisfactory” (Boehm, 1991). The assessment of risks is a pivotal process of risk management (Ghadge et al., 2013). Several approaches to manage risks are described in literature (Coyle and Conboy, 2009), such as research papers on risk management in the fields of finance, healthcare, project management, and supply chain management (Ghadge et al., 2013). But risk management for e-invoice processes has not yet been determined.

Earlier research focused mainly on EDI (Kioses et al., 2007). But, the landscape for the exchange of e-invoices changed. Pre-tax deduction based on e-invoices has been legal according to EU law since 2001, and the development of new technologies lead to a variety of e-invoicing solutions (Kabak and Dogac, 2010; Legner and Wende, 2006). These solutions differ in functional scope, level of process integration, and technical capabilities. According to Kreuzer et al. (2013) technological readiness is a critical factor in the context of e-invoice processes and it also affects the adoption of e-invoice solutions. Currently, the main research focus is on the identification of critical success factors affecting the dispersion of the exchange of e-invoices. Theoretical models are evaluated or requisites based on surveys are derived (e.g., Arendsen and Wijngaert, 2011; Bernius et al., 2013; Haag et al., 2013; Hernandez-Ortega and Jimenez-Martinez, 2012). Hernandez-Ortega et al. (2014) adapt and evaluate adoption models to analyze the continuance of e-invoicing in Spanish companies. Bernius et al. (2013) analyzed potential solutions for the introduction of electronic invoicing based on cost-utility analysis for the German public sector. Barriers to e-invoice participation - regardless of the company’s size - are lack of IS and business strategy, high implementation and processing costs, legal uncertainty, and lack of a standard e-invoice process (Legner and Wende, 2006; Sandberg et al., 2009). Often business partners are not ready for e-invoices with regard to process and IS maturity and know how, or they are just not willing to adopt e-invoice processes (Legner and Wende, 2006; Lumiaho and Rämänen, 2011; Penttinen et al., 2009). Another research stream addresses interoperability issues and business models (e.g., Beck et al., 2002; Gómez-Pérez et al., 2012; Kivijäri et al., 2012; Penttinen et al., 2008).

This research focuses on a qualitative risk assessment of e-invoice processes. The risks of e-invoice processes can be described as uncertain events that can have a negative impact on the business processes and on compliance with legal regulations. The exchange of e-invoices among organizations is still low (European Commission, 2010; Eurostat 2014). Some companies are afraid of losing their right to take pre-tax deduction and still insist on paper-based invoices (Haag et al., 2013). In addition, companies are concerned about security issues such as the authenticity and integrity of invoices (Haag et al., 2013). Other risks for companies are technological in nature or from lock-in effects when the change of a standard used or of a service provider is associated with unbearable costs (Gómez-Pérez et al., 2012).

3 Research Design and Methodology

3.1 Identification of the critical risk factors from literature

In order to identify the critical risk factors of e-invoice processes, a structured review of e-invoice literature was conducted. First, online literature databases such as ACM Digital Library, AIS Electronic Library, EBSCO Business Source Complete, Google Scholar, IEEE Xplore Digital Library, Ingentaconnect, Science Direct, and Springerlink are searched. The search terms include “electronic

invoicing”, “electronic invoice”, “invoice and e-payment”, “invoice and e-procurement” and affiliated keywords. The search was restricted to scientific papers that are written in English and German. Primary papers with an European focus were considered due to common legal framework. Appropriate literature from the EC or EU was added as the e-invoice topic is a part of the Europe 2020 strategy (European Commission, 2010), and practical studies completed the database.

Risk Factor	Angeles and Nath 2007	Arendsen and Wijngaert 2011	Beck et al. 2002	Edelmann and Sintonen 2006	EU Expert Group on e-Invoicing 2009	European Commission 2010	European Union 2010	Fairchild 2004	Gómez-Pérez et al. 2012	Haag et al. 2013	Hag 2007	Hernández-Ortega 2012	Hernández-Ortega and Jimenez-Martinez 2012	Kabak and Dogac 2010	Keifer 2011	Kivijärvi et al. 2012	Kreuzer et al. 2013	Legner and Wende 2006	Lumiaho and Rämänen 2011	Netter and Pernu 2009	Netter et al. 2010	Penttinen and Hyttinen 2008	Penttinen and Tuunainen 2011	Penttinen et al. 2008	Salmony and Harald 2010	Sandberg et al. 2009	Tanner et al. 2008
Disruption or contravention due to legal ignorance				x	x				x																		
Disruption or contravention due to different international legal regulations									x						x		x	x						x			
Not acting in accordance to law due to a lack of knowledge within the company										x																x	x
Master data which is relevant for invoices is lacking quality																											x
Lack of knowledge of additional costs (implementation, operation,...)	x	x		x					x										x				x		x	x	
Dependency upon customer																							x			x	
Too few business partner are using electronic invoices				x				x		x									x								
Lack of willingness by suppliers to change process																x		x									x
Additional expenses due to parallel invoice processes (entry of invoice data in web portals, paper-based and electronic invoices,...)												x								x							
Electronic archive is lacking or is not conforming with the law																					x						
Lack of adequate information systems within the company (slow internet	x								x														x	x			x
Sunk costs (e.g. printing of electronic invoices, operating parallel processes,...)	x								x										x								
Error proneness due to lack of experience of service provider																x											
Lack of functionality in service offers	x																		x								
Adoption of too many standards						x																				x	x
Use of different service offers due to lack of interoperability of service systems (web portals,...)															x							x			x		
Use of parallel systems due to lack of interoperability of information systems	x			x	x			x									x	x						x			x
Dependency upon used standard																											
Selection of a standard that is not future-proof	x					x				x									x							x	
Loss of invoice (spam filter, errors in archiving...)										x		x	x														
External threat to invoice (spying out of content, deletion of invoice file, falsified sender or receiver...)																					x	x					
Lack of data integrity in invoice processes (falsified data)										x		x	x								x						
Lack of readability in invoice processes (visual representation of invoice)							x																				
Reputation loss due to non-adaption of electronic invoices																								x			
Not exploiting competitive advantage due to non-adaption of electronic				x										x	x												x
Adaption due to external pressure of business partners or government																		x									
Error proneness of financial accounting					x																			x			
Error proneness of the control procedure of the payment process					x																						
Error proneness of the control procedure of the inbound invoice process					x																						
Incomplete adaption of the business processes											x										x						
Lack of acceptance by top management											x																
Lack of willingness for internal and external process changes inside the												x							x								
Lack of acceptance of new processes by staff	x									x									x								
More difficult cash payment process																											
Irreversibility of process changes				x																							
Lack of comprehensive process and IT know-how of consultant	x																										x
Lack of strategic planning																											x
*Lack of acceptance regarding electronic invoices by tax authorities	x																										
*Lack of process ownership and responsibility																						x	x				
*More difficult error tracing due to process complexity																								x			
*Underestimated adaption costs (process, information systems,...)				x							x																
*Dependency on service provider (system, standard, network of																											
*Dependency on supplier											x																
*Expected benefits are missing or are not measurable					x						x	x															x
*Lack of willingness of customers to change process						x																					
*Selection of a inadequate information system												x															x
*Too low transaction volumes result in higher costs																											x
*Lack of adaptability of used information system																											x

*Risk Factors excluded after principal component analysis

Table 1. 48 risk factors resulting from literature review

Finally, a total of 75 published papers were analyzed, applying Mayring’s qualitative inductive content analysis technique (Mayring, 2000). The critical success factors mentioned in 27 of these papers were

extracted to 215 text passages. These passages were then categorized inductively and the suitability of the content for identifying risks was checked. Finally, the researchers discussed the categories and identified 48 potential risk factors for e-invoice processes. The result of a concept-centric categorization of risks from the literature review as suggested by Webster and Watson (2002) is presented in Table 1. In order to cover the risk factors to the best possible extent some logical overlaps in risk factors were accepted. The subsequent quantitative-empirical analysis was to uncover redundancies and too strong correlations. The risk factors marked with an asterisk are later excluded in empirical analysis as will be explained in the methodology section.

3.2 Survey design, data collection and analysis methods

In order to confirm, analyze, and explore critical risk factors of e-invoice processes in a standardized approach with a large population of experts, the survey methodology is applied (Groves et al., 2011). A web-based survey that focused on experts with comprehensive knowledge of e-invoice processes was conducted (<http://www.iwi.uni-hannover.de/survey0.html>). The empirical analysis of the identified risk factors was carried out in a qualitative manner. The experts were asked to assess the risks based on their experience or intuition (Coyle and Conboy, 2009). Each risk factor was expressed so that it can be assessed on a 5-point Likert scale. In the survey, the experts indicated from their subjective experience whether the probability of occurrence and the risk value of the risk factor was very low(1), low(2), middle(3), high(4), or very high(5).

To ensure content validity, a pre-test was conducted with four faculty members who are experienced in quantitative research and four experts for e-invoice processes. The wording of some questions was modified according to their advice. The final questionnaire addressed 48 potential risk factors roughly grouped into strategic, process-related, and technical factors in order to structure the survey. The survey consisted of five main sections with a total of 21 questions. Section 1 asked for the demographics of the experts and companies with five questions. Sections 2 and 3 contained the assessment of risk probability respectively risk value with three questions for each groups of risk factors. Section 3 included two open-ended questions for further risk factors and general feedback to risk management for e-invoice processes. Section 4 investigated further background information of the company and its invoice processes. In the last section, the experts were able to ask for the results of the survey. The invitation to the web-based survey was sent to 282 experts on electronic invoicing via email. The experts were selected from previous relevant empiric inquiries, business relations, and web pages with e-invoice reference. Reminder emails were sent after one and two weeks. The experts were assured that their responses will be treated with anonymity and confidentiality and were asked to forward the study to other experts as appropriate. A link to the survey was published on the “Verband elektronische Rechnung” website (Engl.: Association of e-invoices; www.verband-e-rechnung.org) and in suitable groups of the professional networking websites xing.com. The survey was available in German and English, and took place in March and April 2014. Due to the specific profile of the target group, the generated expert base was expected to be rather small. This was compensated by the survey responses: For the German survey, 102 responses were received and for the English survey 22 responses were received. The assessment of risk probability was answered by 106 experts (38% return rate). The assessment of risk value was answered by 88 experts (31% return rate). The relatively high quit rate after the first section of questions can be explained by the high total number of factors to be evaluated by the respondents. A summary of the relevant demographic characteristics of the experts is provided in Figure 1.

Respondents position (N=105)			Industry (N= 105)		
Frequency	Percentage		Frequency	Percentage	
Managing director	21	20.0	Information technology	41	38.7
Project manager	16	15.2	Consulting	15	14.2
Consultant	15	14.3	Automotive	9	8.5
Project member	13	12.4	Retail and wholesale	7	6.6
Department manager accounting	10	9.5	Public administration	7	6.6
Accounting clerk	8	7.6	Chambers and interest groups	5	4.7
Process owner	8	7.6	Food and beverage	4	3.8
IT expert	7	6.7	Education	3	2.8
Accounting consultant	2	1.9	Tourism/entertainment	3	2.8
Department manager IT	2	1.9	Services	3	2.8
Managing board	2	1.9	Manufacturing	2	1.9
Researcher	1	1.0	Financial services/insurance	2	1.9
			Health care	2	1.9
			Telecommunication	2	1.9
Active decision making for electronic invoicing (N=83)			Years in current position (N=102)		
Yes	22	26.5	Median = 9.14	SD = 6.427	
No	61	73.5			
Company size - # of employees (N=106)			Company size - turnover in EURO (N=99)		
Micro (less than 10)	23	21.7	Micro (less than 2 million Euro)	40	40.4
Small (less than 50)	25	23.6	Small (less than 10 million Euro)	19	19.2
Medium-sized (less than 250)	14	13.2	Medium (less than 50 million Euro)	9	9.1
Big (more than 250)	58	54.7	Large (more than 50 million Euro)	31	31.3

Figure 1. Sample demographics

The statistical analysis of collected data was performed using IBM SPSS Statistics 21. An exploratory principal component analysis (PCA) with VARIMAX rotation was used to reduce the list of the risk factors and to cluster and prioritize them (see e.g. Bartholomew et al., 2002). To find the most adequate rotation method orthogonal and oblique rotation methods offered by SPSS were all applied with the objective to attain a simple structure of results (Kline, 2014). VARIMAX is the most commonly used rotation method in combination with PCA in social sciences. As this method also provided the least cross-correlation of the rotated factor loading, it was ultimately chosen as the adequate rotation method for the underlying data set. The measure of adequacy (MSA) values of the suggested risk factors are above 0.6 for all factors except for one. This factor was excluded from further analysis. The resulting Kaiser-Meyer-Olkin (KMO) value is 0.811 and thus the sample is adequate and valid in terms of the factor analysis. The Bartlett's test of sphericity is significant. Applying the criteria of eigenvalue greater than one and coefficient value greater than 0.5, the initial list of 48 risk factors (see Table 1) was reduced to 37 risk factors and statistically grouped into ten dimensions by the PCA. These dimensions were discussed in the light of the literature review and labeled (see Table 2). The rotated factor loading of the included risk factors and their affiliation with one of the 10 dimension are presented in Table 3. The rotated factor loadings are based on the measurements for risk probability as this section of questions has been answered by all respondents and its interpretation is consistent in terms of importance and ranking for the risk management of e-invoice processes. The values explain at least 50 percent of the variance of the associated item. The cut-off is chosen slightly higher than the usual (0.3 or 0.4) in order to improve interpretation. Table 2 provides the total variance explained by the reduced set of factors after the final iteration. The solution with ten risk dimensions achieves a good fit by reaching approx. 70 percent of total variance explained. The reliability of the ten risk dimensions was tested for internal consistency using Cronbach's alpha α value. Eight out of ten values were above the threshold for acceptable (<0.7) and good (<0.8) internal correlation. Thus they can be assumed to be reliable. The two other dimensions labeled as "change management" and "project management" have low values of α (0.539 and 0.511). The low internal consistency associated with low α can still be accepted in this case as both risk dimensions represent a set of multiple topics. Acknowledging that both dimensions contain of merely two factors, more factors need to be included in future research. The means of the risk dimensions can be compared in a one-way analysis of variance (ANOVA) in order to prioritize dimensions in the context of the underlying data (see Table 3).

Risk Dimension	Initial Eigenvalues			Extraction Sum of Squared Loadings			Rotation Sum of Squared Loadings			Reliability - Cronbach's Alpha
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	
Strategy	16.086	34.225	34.225	16.086	34.225	34.225	4.133	8.794	8.794	0.838
Process Organization	3.425	7.287	41.512	3.425	7.287	41.512	3.986	8.480	17.274	0.752
System	2.524	5.371	46.883	2.524	5.371	46.883	3.895	8.287	25.561	0.836
Standard	1.995	4.245	51.128	1.995	4.245	51.128	3.825	8.139	33.700	0.853
Security	1.907	4.057	55.185	1.907	4.057	55.185	3.536	7.524	41.223	0.778
Environment	1.517	3.227	58.412	1.517	3.227	58.412	3.258	6.932	48.156	0.774
Process Execution	1.494	3.178	61.590	1.494	3.178	61.590	2.907	6.185	54.341	0.810
Acceptance	1.372	2.918	64.508	1.372	2.918	64.508	2.510	5.340	59.681	0.772
Change Management	1.289	2.743	67.251	1.289	2.743	67.251	2.441	5.194	64.875	0.539
Project Management	1.106	2.354	69.605	1.106	2.354	69.605	2.040	4.340	69.215	0.511

Table 2. Total variance explained after final iteration and reliability of risk dimensions

4 Discussion of Results

The factor analysis based on the responses for risk probability reveals that the initially identified risk factors are relevant but can be reduced from 48 risk factors to 37 risk factors. The risk factors are grouped into ten dimensions according to the results of the PCA. These dimensions and their included risk factors with the statistical values are presented in Table 3.

Risk Dimension	Included Risk Factor	Rotated Factor Loadings	Risk Probability		Risk Value		One-way ANOVA mean
			Mean	SD	Mean	SD	
Strategy	Disruption or contravention due to legal ignorance	.713	2.604	1.084	2.563	1.097	2.738
	Disruption or contravention due to different international legal regulations	.637	2.848	1.026	2.721	1.081	
	Not acting in accordance to law due to a lack of knowledge within the company	.633	2.654	.993	2.655	1.066	
	Master data that is relevant for invoices is lacking quality	.558	2.733	1.059	2.724	1.117	
	Lack of knowledge of additional costs (implementation, operation,...)	.544	2.865	1.053	2.828	.955	
Process Organization	Dependency on customer	.521	2.781	1.028	2.759	.976	3.079
	Too few business partner are using electronic invoices	.805	3.198	1.125	3.080	1.059	
System	Lack of willingness by suppliers to change process	.742	3.057	.984	3.011	1.006	2.614
	Additional expenses due to parallel invoice processes (entry of invoice data in web portals, paper-based and electronic invoices,...)	.601	2.981	1.215	2.908	1.007	
	Electronic archive is lacking or is not legally compliant	.691	2.781	1.209	2.977	1.198	
	Lack of adequate information systems within the company (slow internet connection, software solutions do not suit electronic invoices,...)	.598	2.566	1.121	2.402	1.005	
	Sunk costs (e.g. printing of electronic invoices, operating parallel processes,...)	.566	2.705	1.055	2.709	1.016	
Standard	Error proneness due to lack of experience of service provider	.542	2.467	1.029	2.558	1.001	2.835
	Lack of functionality in service offers	.534	2.538	.968	2.494	1.031	
	Adoption of too many standards	.737	2.868	1.155	2.647	1.088	
	Use of different service offers due to lack of interoperability of service systems (web portals,...)	.635	3.125	1.146	2.871	1.044	
Security	Use of parallel systems due to lack of interoperability of information systems	.629	2.875	1.077	2.885	1.028	2.250
	Dependency on standard being used	.542	2.781	.980	2.694	1.012	
	Selection of a standard that is not future-proof	.524	2.575	1.014	2.698	1.085	
Environment	Loss of invoice (spam filter, errors in archiving...)	.818	2.226	1.035	2.345	1.055	2.833
	External threat to invoice (spying out of content, deletion of invoice file, falsified sender or receiver...)	.741	2.094	.921	2.345	1.087	
	Lack of data integrity in invoice processes (falsified data)	.642	2.133	.889	2.483	1.109	
Process Execution	Lack of readability in invoice processes (visual representation of invoice)	.517	2.115	1.008	2.161	.951	2.296
	Reputation loss due to non-adaption of electronic invoices	.805	2.743	1.092	2.644	1.000	
	Not exploiting competitive advantage due to non-adoption of electronic invoices	.785	2.876	1.053	2.713	.939	
	Adoption due to external pressure from business partners or government	.726	2.885	1.036	2.871	.910	
Acceptance	Error proneness of financial accounting	.814	1.991	.834	2.198	.892	2.615
	Error proneness of the control procedure of the payment process	.671	2.067	.862	2.310	.968	
	Error proneness of the control procedure of the inbound invoice process	.655	2.264	.939	2.287	.875	
Change Management	Incomplete adoption of the business processes	.620	2.857	.945	2.802	.905	2.123
	Lack of acceptance by top management	.802	2.619	1.095	2.655	1.098	
Project Management	Lack of willingness for internal and external process changes inside the company	.558	3.198	1.099	3.035	.951	2.755
	Lack of acceptance of new processes by staff	.545	2.802	1.018	2.793	1.058	
Management	More difficult cash payment process	.781	1.971	.955	2.128	.968	2.123
	Irreversibility of process changes	.526	2.283	.778	2.400	.928	
Management	Lack of comprehensive process and IT know-how of consultant	.626	2.613	1.065	2.701	.990	2.755
	Lack of strategic planning	.533	2.896	1.112	2.897	1.012	

Table 3. Dimensions and factors – rotated factor loadings and descriptive statistics

The mean values for risk probability (see Table 3) revealed that the experts perceive the risk dimension “process organization” as the most risky dimension. This dimension combines risk factors that relate to the administration of internal and external processes. This includes the usage rate of e-invoices by business partners, the suppliers’ willingness to change processes and the necessity for parallel invoice processes. The first two risk factors represent issues that are difficult to control or influence. A large percentage of companies claim that business partners are not ready to adopt electronic invoices (Haq, 2007; Lumiaho and Rämänen, 2011). This often results in reluctance to implement e-invoicing or at least leads to parallel processing of paper and electronic invoices. The higher operational costs can well explain the high perceived riskiness of these factors. In response to the open-ended question, respondents wrote that the issue of shared responsibilities bears certain risks. The questions arising in master data management, design of dunning processes and system-related project scheduling is critical for electronic invoice implementation.

The risk dimension “standard” is ranked second on the risk probability scale. The experts perceive issues regarding selecting the “right” standard and a lack of interoperability of IS as potentially significant threats to e-invoice processes. The necessity to support multiple standards and the associated efforts in adequate mapping of transmitted message content triggers the experts risk perception (European Commission, 2010). The lock-in effects can be another reason to consider this dimension to be high risk, as the transition from one standard to another can be difficult and costly (Penttinen and Hyytäinen, 2008). Standard selection is an important and complex project, as the risk of choosing a standard that is not future-proof is relatively high. The European Commission (2010) criticizes the market fragmentation resulting from the diversity of data and usage requirements. Especially when approaching the challenge to find the adequate standard on a global scale, larger companies face a higher risk. Remarkably, data analysis shows that beside the largest companies (mean=3.25), the micro companies with less than 10 employees perceive this risk as being second highest (mean=2.78). This can be explained by their limited resources and technical know-how. In order to promote e-invoicing, all public authorities in the EU will have to accept e-invoices in the European standard that is currently developed by the EU as from 2020 (European Union, 2014).

The risk dimension “environment” deals with external pressure facing companies that affects their reputation or the achievement of competitive advantages through e-invoice processes, for example. Without a strategic approach to e-invoice adoption, companies risk being left behind while competitors make progress in their operative processes (Keifer, 2011). Some EU member states have already established mandatory e-invoicing to public authorities such as Denmark and Finland. Hernandez-Ortega et al. (2014) identified that a leader company can influence their business partner to accept e-invoices. They explained the example Carrefour Spain that asked its suppliers to use e-invoicing. In seven months the exchange of e-invoices with the suppliers increased from around 1% to 93% of the total (Hernandez-Ortega et al., 2014). Middle-sized companies score highest in their perception of risk from adoption of e-invoices through external pressure (mean=3.67). The data does not show that the risk associated with reputation loss is higher for larger companies.

The risk dimension “project management” includes risks that concern the lack of strategic, process and technological know-how of the project manager and consultant. However, the statistical reliability of this risk dimension is rather poor ($\alpha=0.511$). Because this dimension comprises only two risk factors, it can be concluded that further aspects are lacking to complete it. However, the factor analysis identified this risk dimension as being statistically significant, and due to the high mean values this dimension was not removed. Strategic IT and business planning especially concern procurement, where e-invoicing can play a role in supplier assessment and negotiation criteria (Tanner et al., 2008). In an open-ended question, one respondent argued that relevant practical IT know how for e-invoices is usually lacking in-house. This is also the case for the ordinary consultants who do not have relevant IT knowledge for e-invoices.

The risk dimension “strategy” combines all risks that relate to both legal and strategic questions and to the detailed process cost analysis. Management must decide which procedures are adopted to ensure compliant e-invoice processes on a national and international level (Kreuzer et al., 2013). They determine whether the laws are maintained strictly or whether the legal scope is fully utilized, for example. Process cost analysis is an important issue especially for the very small (mean=2.85) and the large companies (mean=4.0). The latter struggle to estimate costs in their complex and diversified invoice processes. Both usually have no deep understanding of the detailed cost structure in their supporting processes. Master data quality is another risk factor stemming from underestimated strategic importance (Tanner et al., 2008). Further, management determines the strategic position of customers. Here, especially the relationship with regular customers needs to be analyzed to uncover dependencies (Sandberg et al., 2009).

The risk dimension “acceptance” deals with the willingness toward internal and external process change within a company. That includes involvement of both top management and staff. Respondents from micro and small companies perceive the risks of resistance for process changes as highest (mean=3.40). Paper invoices are often considered to be the best fit to the current operating procedure (Haag et al., 2013). Sandberg et al. (2009) argues that innovativeness and risk appetite are strongly correlated when it comes to e-invoice adoption.

The risk dimension “system” is another technological aspect. This dimension includes risk factors that concern IS within the company, the established range of services and technological processes with service providers. Further, risks related to the unexpected costs of poor performing IS and technological processes are also included in this dimension. The current IS in most companies is not sufficient for e-invoice processes, as argued by a respondent to an open-ended question. Often adoption costs cannot be precisely estimated as paper-based and electronic processes are run parallel (Lumiaho and Rämänen, 2011). Challenges with the electronic archive and IS support for e-invoices stem from unclear legal regulations or a lack of understanding of the underlying technology. Not being able to add attachments to e-invoices, is an example of an inadequate IS (Penttinen et al., 2008).

The risk dimension “process execution” combines all risk factors that relate directly to the execution of the e-invoice processes such as the financial accounting processes, the payment processes and the inbound invoice processes. The major risks arise from the receivers’ systems and their internal control (EU Expert Group on e-Invoicing, 2009). Larger companies perceive these risks as being smaller compared to middle-sized and small companies, although their transaction volumes and process complexity are usually higher. At the same time, they responded that incomplete adoption of business processes presents a higher risk (mean=3.2). This could result from the fact that they better understand the impact of invoicing to the process of e-procurement (Haag et al., 2013). Additionally, respondents argued that only deeply integrated and automated e-invoice processes are superior to paper-based processes in term of risk. Lower integration levels, such as PDF invoices via email, are associated with very high manipulation threats.

The risk dimension “security” is remarkably not perceived as being very risky by the respondents. As argued in the open-ended question, the threats for electronic invoices and paper invoices are comparable. Therefore, security related risks are not rated as high by the experts. However, technical manipulations to e-invoices cannot be detected as easy by the responsible accounting personnel. Depending on the established processes and the IS being used, these included risk factors must also be considered in risk assessment of e-invoice processes. Insecure transmission channels, such as the internet, may make e-invoice processes vulnerable if no countermeasures are implemented (Netter et al., 2010). Risks include the possibility of loss, the threat of external criminal attack, and the lack of data integrity and readability. Currently, success of e-invoice processes does not fully depend on compliance, but on an adequate level of process integration.

Finally, the risk dimension “change management” includes risk factors that relate directly to process changes. The irreversibility of investments (Edelmann and Sintonen, 2011) and the difficult transition

for cash payment processes (Penttinen and Tuunainen, 2011) are two examples. However, the statistical reliability of this risk dimension is rather poor as measured by Cronbach's Alpha and it includes only two risk factors. As change management is multifaceted discipline, internal consistency cannot be expected in this risk dimension. But, further risk factors can be included which will increase the reliability of this dimension. This dimension is identified as statistically significant by the factor analysis.

5 Recommendations

Due to its commercial and legal impact, the invoice is a pivotal document with strategic and operational consequences for companies. To achieve competitive advantage companies digitalize their business processes. However, the opportunities are challenged by internal and external risks and have to be proven in the relationships with business partners and other stakeholders. The most obvious risks are the legal consequences. But the study revealed that **process organization** risks are considered to be the highest. Companies are recommended to prove and determine their internal and external processes. For example, they are supposed to analyze how many of the business partners already use e-invoice processes and whether the supported processes align to their internal processes. Despite the obvious benefits of e-invoice processes, business partners must often be convinced to participate. In order to convince and support the business partners, companies must be conscious of potential risk factors of e-invoice processes. Companies and their business partners need to be able to analyze and assess the critical risk factors in accordance with the individual situation. Further, all business partners need to be involved in the processes. They share responsibilities and functions that make both, e-invoice processes and all partners, benefit alike. Companies have to decide whether they accept parallel processing of paper and electronic invoices. It is recommended that they try to handle paper and electronic invoices similarly as soon as possible in their processing by converting into a single standard at an earliest possible process step. This includes the determination of responsibilities. Especially, SMEs are often not sure about the risks and opportunities of e-invoice processes. It is recommended to ask their tax consultant, corresponding chamber of commerce, or service provider for support. Thus, not only companies but also politicians, organizations, committees, and other stakeholders in a leading position need to be aware of risks and opportunities of the different solutions of e-invoicing. It is recommended that they support companies in their decision to implement and use e-invoice processes. Providing best practices of established e-invoice solutions can also be helpful. In this context, both the risks and the opportunities need to be compared with each other. Recommendations for businesses are to be presented. Tax authorities are supposed to provide reliable suggestions for the procedure documentation, so that all participants understand it and are assured to act compliant with law.

Companies are recommended to analyze the risks concerning the selection, implementation, and use of **standards**. In order not to lose a business partner, companies are forced not only to implement e-invoice processes, but also to use a specific standard. As many standards exist for data structure and transmission, companies have to implement multiple standards simultaneously. Although they can outsource to a service provider, there are other risks and questions to be considered. According to some experts, the newly developed German invoice data standard ZUGFeRD will reduce some of the identified risks. Invoices in accordance to the standard ZUGFeRD are a combination of PDF and integrated structured XML-data. This standard facilitates both manual and automatic processing.

The **system** risks are closely connected with the risk dimension standard. Some of the experts explained that the exchange of structured data and integrated IS reduces risks. IS have to support the business processes, but they also are required to determine how risky processes can be. Several IS are used that are not adequate for e-invoice processes, or no integration and exchange of data is possible. This means that a consistently integrated procure-to-pay process is not feasible. Therefore, companies are supposed to ensure that the business processes are fully supported by IS and also that electronic archiving of e-invoices is provided. They have to consider the conformity with their processes.

Further, companies are advised to consider the alignment of e-invoice processes with their **strategy**. Management is supposed to decide which procedures are adopted and whether laws are maintained strictly or whether legal scope is exploited. In order to measure the benefits of e-invoice processes, companies are recommended to perform process cost analysis. This is not only important for process optimization and redesign but also to involve top management (**acceptance**).

Although the **security** dimension is not perceived as very risky by the experts, companies are also supposed to take care of security issues. Often these issues also support the process organization. For example, companies can establish an e-mail address only for e-invoice matters and this address is not mentioned in public. Further, they can avoid the use of insecure transmission channels.

Finally, risk assessment is a continuous process. New technologies, laws and other business environment change the situation so that identification of new risks and a reassessment of existing risk factors are necessary.

6 Theoretical and Practical Implications

It is the first study that identifies and analyzes critical risk factors of e-invoice processes. The identification and analysis of risk factors is an initial approach to risk assessment of e-invoices processes. These factors are also clustered in risk dimensions. Risk factor probability and risk value in terms of expected loss were evaluated for each risk factor by survey respondents. The results have shown that the experts found it difficult to distinguish between these two estimations applying the 5-point-Likert scale. It is not yet possible to establish a risk matrix for e-invoice processes based on this data as risk probability and risk value are linearly correlated according to the experts' estimation. The causal effects need to be determined in future research. One expert explained that e-invoices are nothing new and that there is no need to deal with this issue anymore, but this study also has implications for practice. The analysis of risk factors is relevant because the adoption rate of e-invoicing is low in the EU (European Commission, 2010). The importance of a risk assessment for e-invoice processes is highlighted due to the fact that nearly half of the contacted experts taking part in the survey were interested in the results of the study. From a practical perspective this research revealed ten dimensions of risk factors that need to be considered. The 37 identified and statistically significant factors are an initial approach for the practice. These factors will be analyzed and assessed with individual measurements and derivations for the handling. Perhaps there are already solutions within the companies to mitigate some of the mentioned risks. Based on the established processes and IS being used, companies need to investigate whether other risk factors have to be analyzed. This research provides support especially for companies that are starting to implement e-invoice processes. However, companies that decline the e-invoice process can use these results as a starting point to reconsidering their decision. Results can support companies that are trying to convince their business partners to implement e-invoice processes. The results can be used as basic frameworks for consultants, organizations, or other stakeholders to analyze and design e-invoice processes and solutions.

7 Limitations

The research was limited to a target group of experts with a comprehensive knowledge of e-invoice processes. Considering this fact, the relatively small number of respondents in the quantitative study generated via internet is considered acceptable for this topic. Due to the unknown population and their distribution the sampling error cannot be estimated (Groves et al., 2011) and thus generalizability of this research is limited. The community's interest is reflected by the high response rate to the survey. Most interviewees are from German-speaking countries. Since about a third of respondents are from large companies, the international perspective is reflected in their responses. Future research will further investigate critical risk factors of e-invoice processes in different countries, in order to make a cross-border comparison and to identify intercultural and national differences. It is recommended that

this expansion of the survey supports also the analysis of dependencies on company sizes and industries. This was not possible due to the sample size of this analysis.

This research concentrates on a specific set of risk factors identified in prior theoretical and practical studies on e-invoicing with an European focus. Although the variance explained by the PCA indicated a good fit with the underlying data set (see Table 2), further risk factors need to be identified to complete the picture. By providing space for comments and open-ended questions, the experts mentioned additional risk factors. Future research needs to investigate corresponding fields of research to complete the factors. There are, for example, various risk factors that affect the success of IS projects mentioned in literature (see Rommel and Gutierrez, 2012). These findings can be applied to the implementation of an e-invoice solution. The risk management subtopic is one part of current research on a maturity model for e-invoice processes. In this context, case studies with companies can be suitable for assessing and evaluating the critical risk factors and applying them to real data and values. That is supported by the fact that, although the selection of the interviewees was mainly focused on experts for e-invoice processes, not all experts were able to answer questions of the assessment of the risk value and quit at this point the survey. This is also reflected in the narrow corridor of mean value for risk and value between 2 and 3 as shown in Table 3. It is necessary to undertake more empirical research to confirm and expand these results and conduct the assessment based on quantitative data that case studies can provide. This is confirmed by the mentioned assumption that the difference between probability and risk value was not clear or that experts had no experience in estimating the risk value. This research focus is on risk assessment that is based on qualitative data, namely subjective estimation. Cox (2008) argues that the constraint of weak consistency, which he interprets as the existence of quantitative measures in risk evaluation, is crucial to the practical usefulness of a risk matrix. Case studies can be suitable to analyze the risks comprehensively and quantitatively. This is also mentioned by Boehm (1991), who suggests that methods such as prototyping, benchmarking, and simulation provide more accurate estimates. Further, the results of this study help to investigate risk management of e-invoice processes as a comprehensive process.

8 Conclusion and Outlook

Based on a literature review the potential risk factors of e-invoice processes are identified. Next, in an online survey, the probability of occurrence and the risk value of each risk factor are evaluated on a 5-point Likert scale from 1 (very low) to 5 (very high). The statistical analysis reveals that most of the identified risk factors are valid and reliable. In order to reduce complexity, the factor analysis is conducted. The factor analysis showed that the initially identified risk factors can be reduced to 37 statistically significant risk factors (RQ1) grouped into ten dimensions (RQ2). The analysis of the mean values prioritizes the ten dimensions: process organization, standard, environment, project management, strategy, acceptance, system, process execution, security, and change management. The dimensions are discussed in the light of the literature review and recommendations are given.

At this stage of research, the focus is solely on the identification of critical risk factors. Future research will investigate and suggest a more complete risk management approach for e-invoice processes. It is necessary to undertake more empirical research to confirm and expand these results and put the assessment in a relevant context such as case studies can reveal. Based on the quantitative data of case studies it is possible to develop a risk matrix for e-invoice processes. Recommendations to control, to handle, and to mitigate risks also need to be developed. Future research will include risk factors of corresponding research fields and of international focus to identify intercultural and national differences. Due to the variety of solutions for e-invoice processes and the different levels of process integration, future research will need to analyze and assess the risk factors in relation to critical factors such as the level of process integration.

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