# WILL XML-BASED ELECTRONIC INVOICE STANDARDS SUCCEED? – AN EXPLORATIVE STUDY

*Complete Research*

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## Abstract

*The digitalization of business processes is a crucial method for cutting down administrative costs, improve productivity in business processes, and achieving process transparency. Since invoices are some of the most important documents exchanged between business partners, it makes sense that invoices be sent and received electronically. There are no formal rules that determine the format of electronic invoices. However, companies benefit most when invoices contain structured data that can be processed automatically. The acceptance and adoption of structured electronic invoicing is generally rather low in the European Union, but it differs significantly among European countries. The electronic data interchange with the invoice standard EDIFACT is most favored by larger companies. An XML-based invoice could fill the gap between EDIFACT invoices and unstructured invoices like PDF and paper invoices. Some European countries have already established a national XML-based invoice standard. This paper addresses critical success factors to the adoption of XML-based standards. In an explorative study with experts, various aspects of acceptance were derived, and the results adapted to the Technology-Organization-Environment framework.*

*Keywords: electronic invoicing, XML-based standard, adoption, technology-organization-environment model.*

## 1 Introduction

Invoices are usually one of the most important documents that are exchanged between business partners, including public authorities. They are an integral part of the order, delivery, payment, and accounting business processes. Further, invoices, including self-bills issued by the receiving party, are the core element 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. As in the case with paper invoices, the integrity of the content, the authenticity of the origin (assurance of identity of the invoice issuer), and the legibility have to be ensured by the taxable companies until the end of the storage period (European Union, 2010). The electronic exchange and processing of invoices promise savings of both cost and time, because they reduce manual work, input errors, printing, and transport costs (European Commission, 2010; Expert Group on e-Invoicing, 2009; Sandberg et al., 2009). Workflows, process transparency and traceability are improved by e-invoice processes (Haag et al., 2013). Despite the obvious benefits, the market penetration of electronic invoices (e-invoices) in the European Union (EU) is still low for business-to-business (B2B) transactions (European Commission, 2010). Some critical success factors to participation in electronic processes are a lack of awareness, unclear business strategy, and missing adequate information systems (IS) for process optimization.

High investment costs, legal uncertainty, lack of standard e-invoice processes, heterogeneous demands of the business partners, and change management efforts are also among the reasons that companies avoid process automation (Haag et al., 2013; Legner and Wende, 2006; Sandberg et al., 2009; Tanner et al., 2008). Since the late 1960s companies have recognized that fast, economic and precise exchange of business data is a strategic factor in opening up potential savings (Kabak and Dogac, 2010; Westarp et al., 1999). As a consequence, orders, delivery notes, and payments and invoicing data have been transmitted via electronic data interchange (EDI). This technology requires both an application-to-application connection between business partners and a standardized IS-processable format (Penttinen et al., 2009; Westarp et al., 1999). EDIFACT was developed as the EDI-standard for administration, commerce and transport (Kreuzer et al., 2013; Westarp et al., 1999). Despite the process-orientated reasons there are some public sector initiatives for supporting e-invoices "with the aim to reduce fraud and increase tax income" (Koch, 2014).

The European Commission (EC) "wants to see e-invoicing become the predominant method of invoicing by 2020 in Europe" (European Commission, 2010). No formal rules determine the format of e-invoices. The invoice can be an unstructured format like PDF or a structured format like EDIFACT or XML. Companies benefit most from e-invoice processes when the invoice contains structured data that can be processed automatically (Expert Group on e-Invoicing, 2009). As a consequence one task for the EC is to support "the development of open and interoperable e-invoicing solutions based on a common standard, paying particular attention to the needs of [small and medium-size companies] SMEs" (European Commission, 2010). EDI with EDIFACT is not profitable for any company 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. It is more suitable for companies that exchange business documents along the entire supply chain and less for SMEs with only a few documents to exchange (Beck et al., 2002; European Commission, 2010; Westarp et al., 1999; Zhu et al., 2006). Companies take part in e-invoicing in order to retain important business partners and not only for the benefits of it (Lumiaho and Rämänen, 2011). To involve any company, an easier standard with fewer contractual agreements and lower investment is necessary. Therefore, an XML-based invoice may fill the gap between the EDIFACT invoices and the unstructured invoices like PDF or paper invoices. There will be no migration from EDIFACT to XML-based invoices, but it is expected, that the overall adoption rate for e-invoices will increase. Prior research on the adoption of electronic invoicing does not focus specifically on the critical success factors of an XML-based invoice standard. Research mostly concentrates on the adoption of e-invoicing with a special focus on, e.g., business-to-government (B2G), SMEs, or a national context (e.g. Arendsen and Wijngaert, 2011; Hernandez-Ortega, 2012; Kreuzer et al., 2013; Penttinen and Hyytiänen, 2008). But e-invoicing has many different aspects with regard to process integration with business partners based on standardized structured invoice data. Consequently, the following research question is addressed:

*How can XML-based standards succeed in electronic invoice transmission and processing?*

Due to a lack of homogeneity of standards within Europe, Germany is used as the case example. Germany also recently published an XML-based invoice standard ZUGFeRD (Zentraler User Guide des Forums elektronische Rechnung Deutschland: "central user guide of the German electronic invoicing forum") in 2014. This standard was developed by the German forum on e-invoicing (FeRD) to support the acceptance and adoption of e-invoices.

First, the theoretical background of e-invoice standards in the EU and the adoption of e-invoicing are introduced. Then, the research design and data collection are explained. Subsequently, the empirical results are discussed and recommendations are derived. Limitations, conclusions and an outlook on future research complete this paper.

# 2 E-Invoicing Standards in the EU: Status Quo and Research Gap

## 2.1 Standards in Europe

The digitalization of business processes is essential to cut administrative costs, to improve productivity in business processes, and to achieve process transparency (EU Expert Group on e-Invoicing, 2009). Especially a fully integrated procure-to-pay process chain provides essential cost savings (EU Expert Group on e-Invoicing, 2009). An important factor is a well-justified and comprehensively designed implementation of e-invoice processes, combined with an awareness of the benefits (Sandberg et al., 2009). Since at least 2004 invoices are allowed to be exchanged electronically in all EU member states. Despite the obvious benefits of e-invoicing, the market penetration of e-invoices in the EU is still low: 29% of EU-based companies with at least 10 employees are sending or receiving at least one structured e-invoice (Eurostat, 2014). Finland and Denmark are leaders in sending and receiving structured e-invoices in the EU (cp. Figure 1). Some EU member states have already established mandatory e-invoicing to public authorities (cp. Figure 1): Austria, Denmark, Finland, Greece, Italy, Norway, Portugal, and Sweden (Koch, 2014; Pihamaa, 2014). France, Spain, and Slovenia have planned it (Koch, 2014; Pihamaa, 2014).

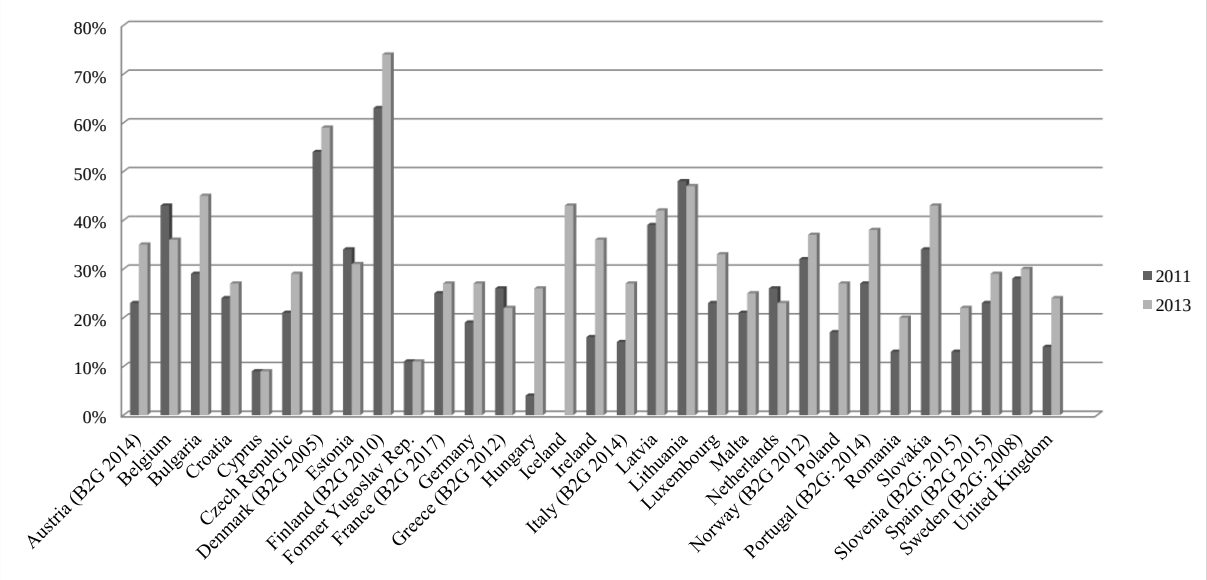


*Figure 1. Companies (with at least 10 employees) of the EU sending/receiving at least one structured e-invoice (Eurostat, 2014)*

In order to tap the full potential of e-invoicing, all business partners involved in B2B and B2G transactions have to accept e-invoices (Haag et al., 2013), even better are structured e-invoices for automatic processing. But there are many different standards for structured e-invoice formats, including industry-specific, national, or company-specific standards (cp. Table 1). Therefore, business partners have to agree on both a common standard for data syntax and on semantics to structure the content of the documents. The implementation costs are high, and not only do they cover software and hardware costs, but also redesigning the company's processes. This is not profitable for all companies due to the high level of complexity, uncertainty about the appropriate standard, lack of know-how, and too few business transactions. Therefore, some EU member states already established structured e-invoice standards for B2G transactions (cp. e.g. Table 1). Mainly, they chose XML-based invoice standards instead of the internationally accepted EDIFACT invoice standard. XML-invoices are human-readable and IS-processable because the data is presented with a clear syntax and semantic information (Huemer, 2000). But there is also the requirement to define the semantic information clearly, so that it is objectively understandable to all users. In contrast, EDIFACT invoices are only understood by IS

and by some experts. They contain data without any meta-information and the meaning of the data is determined by its position in the message (Huemer, 2000). This order is defined by the standardization committee. Advantages of XML include its flexibility and the fact that programming is easy due to the combination of syntax and semantics (Bernius, 2013). Humans feel more comfortable with XML than they do with EDIFACT (Huemer, 2000).

| | Standard | Type | Organization | Advantage | Disadvantage |
|---|---|---|---|---|---|
| **Neutral standards** | EDIFACT | EDIFACT | UN/CEFACT | global used standard, existing market adoption, stable, not industry or country specific; compact data format | complex structure, not easy to read and understand for non-experts, not flexible |
| | CII (Cross Industry Invoice) | XML | UN/CEFACT | global used standard including a general description of invoice processes and data, existing market adoption, stable, not industry or country specific, also for SME | huge structure that will in most cases have to be further restricted |
| | ebXML | XML | UN/CEFACT, OASIS | global used standard collection for data and transmission to conduct e-business processes, existing market adoption, stable, not industry or country specific, also for SME | huge standard family |
| | UBL | XML | OASIS | global used standard, esp. in Europe, existing market adoption, stable, not industry or country specific, also for SME | no standard format or syntax for European invoices, only the semantics of the required information |
| **Industry specific standards** | EANCOM | EDIFACT | GS1 | used standard for the retail industry | low global dispersion |
| | VDA 4938 | EDIFACT | ODETTE | used standard for the automotive industry | industry specific |
| | ISO 20022 | XML/ CII | ISO | used standard for the financial industry that based on the semantic modell form CII | industry specific |
| **Producer spezific standard** | IDoc | IDoc | SAP AG | global disperion because of broad user group | proprietary standard |
| **National standard** | ZUGFeRD | PDFA/3 and XML/CII | Germany | combination PDF and XML; also for SME; developed by representatives for business, government, and relevant committees | new standard but emerging adoption |
| | UBLNES | XML/UBL | UBL Northern European Subset | definition and documentation of business processes and scenarios, of the usage of the specifiction including the validation tools to support e-invocing in the member states | only used in the member states |
| | OIOUBL (formerly: OIOXML) | XML / UBL | Denmark | national adoption in conformity with law; obligatory for B2G in Denmark | no global adoption possible because of customizing to Danish law |
| | Svefaktura | XML / UBL | Sweden | national adoption in conformity with law; obligatory for B2G in Sweden | no global adoption; national standard |
| | Finvoic | XML | Finland | used in a four-party model by local banks; B2B, B2C, B2G; national adoption and conformity with law | no global adoption; national standard |
| | ebInterface | XML | Austria | national adoption in conformity with law; obligatory for B2G in Austria | no global adoption; national standard |
| | facturae | XML | Spain | national adoption in conformity with law; obligatory for B2G in Spain (start 2015) | no global adoption; national standard |

*Table 1. Selected standards in Europe (extension of Cuylen et al., 2013)*

But, none of those standards have become fully accepted in the EU and "most of them are not interoperable with one another" (European Union, 2014). The EU wants to establish a single European standard for the semantic data model on e-invoicing in public procurement that describes the obligatory core elements of an e-invoice 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). This standard will also be suitable for B2B transactions, easy to use for SMEs (Bernius, 2013), and will be based on existing technical specifications such as UN/CEFACT Cross-Industry Invoice (CII) v.2. Further, a list of supported syntaxes will be determined. By the end of 2020 companies and public authorities in the EU have to accept e-invoices in this European standard (European Union, 2014). Every member state is encouraged to start with e-invoicing based on structured invoice data before an uniform standard is developed. Therefore, ZUGFeRD was developed by FeRD in Germany, which promotes e-invoicing in B2B and B2G (cp. http://www.ferd-net.de). An invoice in the ZUGFeRD format is a combination of PDF and integrated

XML data that is based on UN/CEFACT CII. It is interesting to analyze the critical success factors for a migration from EDIFACT invoices to XML-based invoices.

## 2.2 Adoption of an XML-based invoice standard

The majority of the research streams on e-invoicing already address the identification of drivers and critical success factors that affect the diffusion of the e-invoice exchange. According to the technology acceptance model (TAM) by Davis (1989) the acceptance of information technology is identified as the subjective perception of a user that the new technology will improve the efficiency of the business process (perceived usefulness) and that it can be used in a company without much efforts (perceived ease of use). Adoption in the context of the diffusion of innovations (DOI) theory by Rogers (1983) is a decision that makes "full use of an innovation at the best course of action available", and that is based on „the perceived attributes of the innovation, the type of decision making, communications channels used, change agent's efforts and the nature of the social system" (Arendsen and Wijngaert, 2011). Tornatzky and Fleischer (1990) developed another acceptance model containing three dimensions: technology, organization, and environment (TOE). The focus of TOE is the companies and their decision making with regard to technology innovations. Technology includes infrastructure and processes. The structure and resources of companies such as company size, degree of centralization, and hierarchical structure are consolidated in the "organization" dimension. The "environment" dimension describes, for example, competitive, legal, and political environment of the company. IS adoption has been analyzed by a number of empirical studies in various domains. Table 2 demonstrates selected studies on e-invoicing and EDI as well as the closely related areas of electronic business and open standard adoption. Currently, there is no research on the requirements and challenges for the adoption of XML-based invoice standards. Kreuzer et al. (2014) examine in a broader sense XML-based e-invoicing. They analyze the adoption of open-standard IS by SMEs. Cuylen et al. (2013) analyzed the requirements and challenges for the dispersion of e-invoice processes. In this context some general aspects of standardization were identified. In this paper, the research focus is on the adoption of XML-based invoice standards. ZUGFeRD was chosen as a specific example as it is newly developed and introduced to the German market, where no national e-invoice standard existed up to now.

| | Year | Outlet | Focus | | | Theoretical basis | | | | Topic |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | EDI | E-invoicing | Open standards | TOE | TAM | DOI | Other | |
| Delhaye and Lobet-Maris | 1995 | ECIS | x | | x | | | | x | factors of EDI adoption and standard message choice |
| Iacovou et al. | 1995 | MISQ | x | | | | | | x | EDI adoption and technology impact by SMEs |
| Kuan and Chau | 2001 | Information & Management | x | | x | x | | | | EDI adoption by SMEs in Hong Kong |
| Zhu et al. | 2003 | EJIS | | | x | x | | | | electronic business adoption by European firms |
| Edelmann and Sintonen | 2006 | International Journal of Enterprise Network Management | | x | | | | x | | slow adoption rate of e-invoing by Finnish SMEs |
| Zhu et al. | 2006 | MISQ | | | x | | | | x | open standard diffusion |
| Penttinen and Hyytiänen | 2008 | ECIS | | x | | | | x | | e-invoicing adoption in Finnish companies |
| Arendsen and Wijngaert | 2011 | Electronic Government | | x | | | | | x | impact of the government as a launching customer on e-invoicing adoption in Netherlands |
| Juntumaa and Öörni | 2011 | HICSS | | x | | | | | x | partial adoption of e-invoicing |
| Hernandez-Ortega | 2012 | Academia Revista Latinoamericana de Administración | | x | | | x | x | | adoption and subsequent use of e-invoicing in Spanish companies |
| Hernandez-Ortega and Jimenez-Martinez | 2013 | Information Systems and E-Business Management | | x | | | (x) | | | performance of companies that use e-invoicing regularly in Spain |
| Kreuzer et al. | 2013 | Information & Management | | x | | | | | x | factors of e-invoicing adoption at public administrations |
| Kreuzer et al. | 2014 | AMCIS | | x | x | x | | | | adoption of interorganizational IS for e-invoicing among German SMEs |

*Table 2. Selected studies on adoption of e-invoicing and related topics*

A few years ago, major topics being discussed were the electronic signature and legal requirements, like the equal treatment of paper and electronic invoices (Legner and Wende, 2006). These factors were removed by the EU in the directive 2010/45/EU. Hence, the legal circumstances are no longer a

challenge to inhibiting the acceptance and adoption of e-invoices. According to the current legal situation, ensuring the authenticity and the integrity of paper-based invoices and e-invoices alike is required. A company can draw on existing internal control procedures, which are already being used for business reasons to secure and assess the payment process (Cuylen and Breitner, 2012). In the literature, the acceptance and integration of business partners is pointed out (Penttinen et. al., 2009). High effort is required to agree on a single common standard and to find a solution that business partners can both deal with and benefit from it in an automated business process. ZUGFeRD invoices provide a standardized XML-file that allows automatic validation and processing of invoice data. Companies profit mostly from e-invoice standardization when they have a sufficient number of business partners who use or at least accept the same standard. This positive network effects conduct to benefits, which can be even higher the larger the number of participating business partners is (Zhu et al., 2006). Thus the investment can be better justified within the company (Penttinen et al., 2009; Schizas, 2012).

Not only must the effort to convince the business partner be considered, but also the effort to implement the e-invoice standard into existing business processes and IS (Haag et. al., 2013, Sandberg et al., 2009). Integration into company workflows results in cost savings, fewer errors, and more efficient processes because the processing of invoices is accomplished without media disruption (Hernandes-Ortega, 2012). The companies do not see a positive cost-benefit-analysis. This is aggravated by a rejection of employees, executives, and stakeholders of the companies, who argue that there is no need to change the business process (Haag et al. 2013). Organizational readiness is a key factor for implementing or enhancing e-invoicing (Iacovou et al., 1995). The ZUGFeRD standard poses a new possibility. Companies can decide whether to use the PDF file to process the invoice (semi)-manually or the XML-file to process the invoice automatically. Only one format is necessary for all business partners and no adaptations are required. Furthermore, software is needed to create and read the XML-files. The company can develop one or can order one from the software provider, which of course means additional cost. Many potential adopters just see the cost savings for the print and the dispatch and not the time and costs they can save on the entire invoice process (Haag et al., 2013; Penttinen and Hyytiäinen, 2008). Some SMEs do not have the resources to implement automated business processes, for instance the small ones, like butchers, craftpeople or hairdressers. Partly, they do not use any IS and are not prepared for an electronic exchange (Legner and Wende, 2006; Penttinen and Tuunainen, 2011). A further reason for the non-acceptance of e-invoicing and an XML-based standard is the lack of international standards and legislation (Agostini and Naggi, 2009; Penttinen and Hyytiäinen, 2008). ZUGFeRD is based on UN/CEFACT CII (basis for the European standard for B2G transactions), and it can be already used to gain competitive advantages.

In the literature, a lack of knowledge about the necessary IS, the potential of e-invoicing, and the implementation of electronic business processes are often mentioned as critical success factors for the dispersion of e-invoicing (Legner and Wende, 2006; Haag et al., 2013). More information and awareness is needed. FeRD addresses the objective of communicating e-invoices as well as their developed standard (FeRD, 2014). Especially SMEs need information about selection criteria for technology and service providers (Ballantine et. al., 1998; Haag et. al., 2013). As mentioned, harmonization is an important factor. EDI procedures with EDIFACT messages are often used by large companies to exchange electronic business data, not only invoices. This is only viable at a sufficiently high volume of transactions (Balsmeier and Borne, 1995). Many EDIFACT standards are already established. The effort for the transfer from one standard to the ZUGFeRD standard has to be evaluated. Further, the effort for the integration of e-invoices into IS such as accounting and payment systems must be considered. This is important because these factors are responsible for the denial of e-invoicing (Iacovou et al., 1995).

# 3 Research Design and Data Collection

The overall research design is presented in Figure 2. The research process began with a structured literature review to identify all relevant aspects of e-invoice acceptance and standardization. The focus was on XML-based standards with regard to the case example ZUGFeRD. In information system re-

search qualitative methods are applied to analyze in particular the use of IS and technology acceptance. The qualitative approach supports the analysis of cohesion between critical success factors (Martin and McKneally, 1998) and offers deep insights into organizational contexts (Palvia et al., 2003). A qualitative study with semi-structured expert interviews was considered the best method of discussing the critical success factors for adoption and acceptance of a new XML-based invoice standard. The experts were supposed to represent their company's perspective and opinion on e-invoice processes. The first question was formulated as a "warm-up" question so that the expert would start talking and feel comfortable. The following questions were about the status quo, the current invoice formats and processes, the reasons for their decision and factors of awareness as well as questions about the potential of XML-based invoices. All questions were orientated around the literature review. The last question is about the future vision of the expert and his or her opinion of the establishment of XML-based invoices.

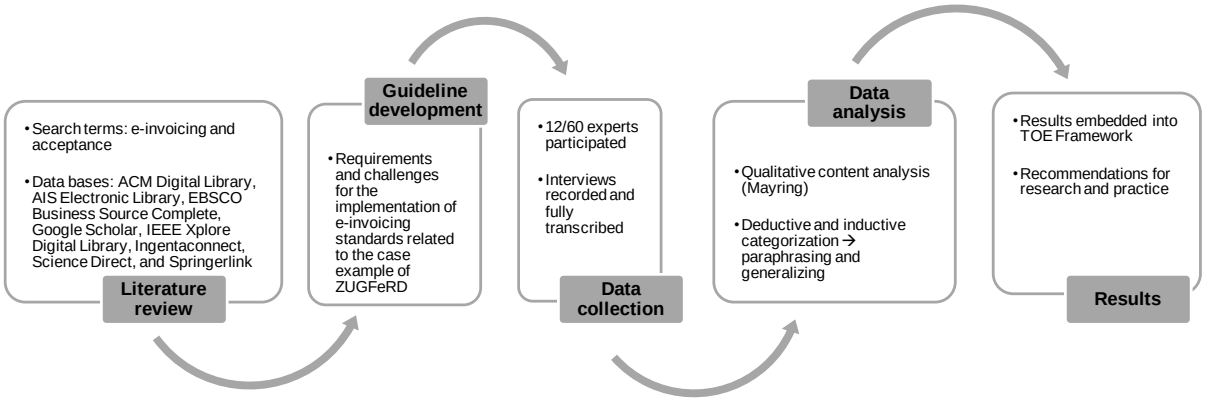


*Figure 2. Research design*

The explorative study with the guideline-based expert interviews was conducted between July and August 2014. All experts (cp. Table 3) were from German companies due to a lack of homogeneity of standards in Europe and the ZUGFeRD case example. They had comprehensive knowledge of e-invoice processes. In order to identify requirements and challenges for adoption of XML-based invoices, we explicitly chose experts from large companies and SMEs which already use e-invoice standards.

| Expert | Company size | ZUGFeRD | EDIFACT | Position | Industry | E-invoice experience | # of codes |
|---|---|---|---|---|---|---|---|
| 1 | SME | | | Head of finance | Retail | 1.5 years | 16 |
| 2 | SME | | | CEO | Management consulting | 5 years | 21 |
| 3 | SME | | ✔ | Head of finance | Retail cooperative | 11 years | 15 |
| 4 | SME | ✔ | ✔ | Department manager of EDI invoice | Invoice service provider | 22 years | 21 |
| 5 | SME | ✔ | ✔ | Senior manager eBusiness | Service provider | 13 years | 21 |
| 6 | SME | | | Head of finance | Logistics | 1-2 years | 11 |
| 7 | SME | | | CEO | Gastronomy | 5 years | 8 |
| 8 | SME | ✔ | | Authorized officer & software engineer | Management consulting | 3 months | 14 |
| 9 | SME | | ✔ | Senior application manager | Logistics | 10 years | 11 |
| 10 | Large | | | Coordinator of special projects | Telecommunication | 8 years | 15 |
| 11 | Large | ✔ | | Head of invoice dispatch | Software/Service provider | 5 years | 14 |
| 12 | Large | ✔ | ✔ | Head of accounting | Groceries | 20 years | 22 |

*Table 3. Interviewed experts and relevant data*

Twelve interviews were conducted, some by phone and some in person. Every interview was recorded with the permission of the expert and transcribed afterwards. It was essential to determine the participants' assessment and experience with both established and new standards of e-invoices. With this information, critical success factors of acceptance and adoption for the implementation of XML-based e-invoice standards were investigated. Furthermore the interviews considered the "status quo" and organizational readiness.

Initially, theoretical main categories were derived from the literature review. Thus, the deductive categories are the followings (in some cases, subcategories can be applied):

- Formats (outgoing and incoming)
- Process
- Standardization and requirements
  - Internationalization
  - Software modification
  - Sufficient number
  - Agreements for XML

For the tool-based content analysis, the MAXQDA software was applied. The uploaded text material provided an opportunity to define the deductive categories accurately and add a category description. The coding agenda determined a basis for the collected categories. Mayring (2014) recommends establishing a definition, an example, and coding rules for each deductive category. In this case, the definition and coding rule were consolidated since the clear categories already delimited the coding. All text passages were assigned to the categories, which are in a coherence with the deductive categories. The inductive category application (open coding procedure) applied new categories. The entire text material was reviewed and new categories were found continuously. Some old categories were replaced, more subcategories were created and later some of them consolidated. In this way we were able to determine the critical success factors of the ZUGFeRD invoices implementation. Mayring (2014) calls this step the summary. Figure 3 shows the final coding system in the MAXQDA software. The larger a point the more codes could be found. Through the appropriated coding of both the deductive and the inductive categories, a paraphrase and a generalization for every code were formulated. The paraphrases structured the code by shortening and reforming the quotations of the experts. The generalization formulated a general statement for every paraphrase. In some cases it was possible to summarize two or more paraphrases to one generalization. Table 4 provides an extract of the definition and coding.

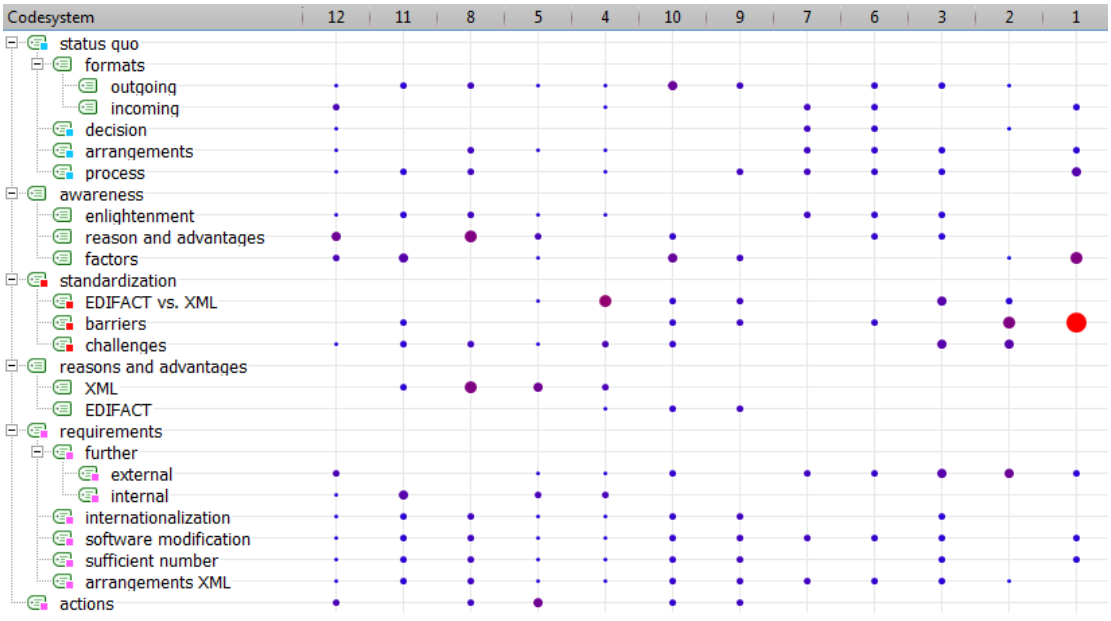


*Figure 3. Excerpt of coding in MAXDA*

The acceptance of e-invoice standards and their adoption can be illustrated in an adjusted and enhanced technology acceptance model, since it can be seen as an advanced and actually not widely used technology in the accounting and payment business processes. The TOE was chosen due to its applicability for EDI adoption in the past (Kreuzer et al., 2014; Ordanini, 2006). The results were integrated into this model in section 4.

| Category | Definition | Code | Paraphrase | Generalization |
|---|---|---|---|---|
| status quo/ decision | The reasons and factors why the enterprises have decided to send the current formats. | There was no other solution in the market rather than EDIFACT or paper. All the other possibilities were legally not permitted. | There was no alternative to EDIFACT and paper. All the others were legally not permitted. | The decision for the formats EDIFACT and paper is influenced by the market situation since other alternatives were legally not |
| awareness/ enlightenment | Statements about the influence of enlightenment. | Yes probably information and enlightenment would support the decision, but I never got it. But I am not the CEO of the company, so maybe he gets it. | Probably steady information could help to think on e-invoices earlier but I never got information or enlightenment. | Enlightenment could affect the acceptance of e-invoices. |
| reason and advantages/ XML | Reasons and advantages of the invoice format XML. | But that is certainly not replacing EDIFACT ... As I said, I do think that it can be adopted in these areas where still paper oder PDF is used, and there it will be definitely an advantage. | I think that there is an adoption for ZUGFeRD and it has an advantage everywhere where only paper or PDF invoices are used. | ZUGFeRD fills the GAP between EDI (EDIFACT invoices) and paper based invoices. |
| … | … | … | … | … |

*Table 4. Code, paraphrase, and generalization*

# 4 Discussion of the Results

We analyzed the text material to identify critical success factors for the integration in the TOE model.

**External Task Environment.** To use a further standard such as ZUGFeRD business partners must also accept this standard. Most of the experts illustrate that a sufficient number of business partners is required to implement a standard efficiently. A minimum quantity of users should always exist to implement a new standard or to replace an existing standard. This is also mentioned in further studies e.g. about migration to open-standards or e-invoicing and e-business in general which deal with network effects. The participants only want to use an e-invoice standard when more business partners take part, which confirms previous research (Zhu et al., 2003; Zhu et al., 2006; Haag et al., 2013). Thus, the critical quantity poses a critical success factor. Therefore companies are needed that are pioneers. In matters of ZUGFeRD the developer companies act mostly as pioneers or as advocates of this standard. The FeRD promotes ZUGFeRD on national and European level. The structure of the business partners and the IS they use were frequently mentioned during the interviews. Companies that have many small business partners who rarely use IS have no inducement to implement structured e-invoice standards, which is also a factor on standard choice within EDI (Delhaye and Lobet-Maris, 1995). Hence this is a further critical success factor. An additional critical success factor is pressure from external business partners or from the market. Due to pressure from business partners and changed market situations companies have to decide whether to maintain or modify their processes and invoicing standards as to not lose any market power or market share. These findings are consistent with quantitative studies of Zhu et al. (2003), Zhu et al. (2006) and Iacovou et al. (1995), where the competitive pressure have a significant positive influence of the adoption of standards. The ZUGFeRD standard is promoted with the advantage that, compared to EDIFACT, no additional agreements are necessary and therefore an interchange with almost any business partner would be possible. Eight experts support this statement and explain that some minor agreements are necessary. Especially no additional agreements are required for the mapping or the structure of the XML-file, since a strict guideline is already in place for the standard. The omission of agreements represents one critical success factor. In addition to this some experts mention that XML-based invoices require more data volume than EDIFACT invoices and therefore more processing time. Therefore some of them reject XML-based invoices generally. Although modern IS can process and transfer high data volumes quickly the transmission and processing time presents a critical success factor. On the one hand as there exist this attitude to XML-based invoices and on the other hand as performance of processing data is an important issue in general. Producers of software and solutions have to consider this. Many companies have not been informed about new technologies and standardizations in e-invoicing and about the legal situation. This could be confirmed by the expert interviews, since many smaller companies (who do not use any structured data) have never heard of EDIFACT, XML-based invoices, and

automated processing. External support in the realm of IT systems and the handling with structured e-invoices might help for the adoption and is also validated in paper about EDI adoption in general (Kuan and Chau, 2011). Many experts pointed out that they do not need any information or awareness. But when assessing their background and their circumstances we come to the conclusion that information and effort from institutes and government could influence their thinking. In any case, what can be also found in articles about EDI adoption (Iacovou et al., 1995; Kuan and Chau, 2001), efforts and the resulting awareness of external organizations or institutions, as well as the legal compliance could affect acceptance and successful implementation which is mentioned in further paper about adoption.

**Organization**. The EDIFACT messages can already be processed automatically and therefore it would be useful to have a process that is close to the existing one. But certain circumstances, such as IS of business partners, the internal need to modify processes and managerial capability must be taken into account (Haag et al., 2013; Zhu et al., 2006). The ZUGFeRD standard provides a simple solution for invoice exchange, but cannot convince companies that demonstrate organizational readiness or are not able to process structured data. Companies consider alternatives when they have many business partners who are not using established standards like EDIFACT. Furthermore, not many companies are asking for the new standard and this is the reason the widespread implementation has not occurred yet. Critical success factors are the expected effort for the modification and organizational readiness in order to have at least an incentive to rethink established invoice processes. These factors are already figured out of Arendsen and Wijngaert (2011) and Iacovou et al. (1995) in studies about e-invoicing to have an influence on adoption and are therefore not specific ones. One internal critical success factor for adoption is internal company communication and thus the acceptance of an XML-based standard. The critical arrays within the standard are important to communicate, leaving little room for other interpretations by providing detailed information for legal and accounting departments. Starting with the decision of a company to start with a standard, business partners need to be convinced. The advantages and benefits for both sides must be presented, not just the request itself, as some participants of the explorative study explained. ZUGFeRD is a common and cross-industry standard and not a specific solution for only one business relationship. The interview partners expected different efforts for it. The conviction of the business partners and thus the mentioned benefits present a strong critical success factor, which is associated with network effects. The larger the network, which uses e.g. ZUGFeRD or open-standard in interorganizational systems, the more business partners will join the network and use the standard (Zhu et al., 2006).

**Technology.** Critical success factors for technology are the market situation of e-invoices and the possibility to use one common, uniform standard for any business relationship. Most of the experts explain that they would adopt the standard if these basic factors are present. The experts often mentioned the current invoice and the mapping compatibility. Not all invoices are suitable for every standard, because not all of the mandatory data in the standard is actually used. The process readiness is already mentioned in studies about e-invoicing and EDI (Haag et al., 2013; Delhaye and Lobet-Maris, 1995). Additionally, the possibility to purchase standardized billing/accounting software and components to create and select the XML-file influences the decision toward one e-invoice standard. The EDIFACT format includes a comprehensive portfolio and the entire supply chain is involved. This does not yet exist for ZUGFeRD. Many participants explain that they would require a larger portfolio of messages as well as a strict guideline to adopt the standard. Hence, the quantity of business documents in an XML-based standard and their detailed specifications influence successful adoption. With larger invoices, a reduction for the structured data set is necessary to keep the file as small as possible state some experts. They compare it to the EDIFACT messages, which are compressed for a low transmission rate. They fear that XML-files have a larger transmission rate due to the internet speed and the size of the files and that therefore errors can occur and the transmission can fail. Not all companies have a modern infrastructure. XML-based invoices are not only exchanged between IS but also via e-mail. Some e-mail post boxes have limited the maximum size of an e-mail message. A further critical success factor is therefore the compatibility with large amounts of invoice data. On the European level ZUGFeRD has not been adopted yet, since EDIFACT messages and national standards in XML like ebInterface in Austria or FINVOICE in Finland already exist (cp. Table 1). However, the

ZUGFeRD standard is based on international specifications for the European market (e.g. UN/CEFACT CII) and has the potential to be adopted by European countries. The participants of the underlying study have no unified opinion about this topic, since some are convinced that the standard can be used and some do not see a market for it. In opinion of the experts the standard is not more accepted compared to previous ones and therefore currently has no competitive advantage, which is e.g. not consistent with a study about e-business, where the competitive pressure is the only significant environmental factor for the adoption (Zhu et al., 2003). However, in this study the internationality of a standard is not a dominant critical success factor. From the interview material it can be inferred that a modifying existing software is possible. However, a new development or a purchase of a software component for XML-based invoices is more efficient since a new or additional processes will occur. The existing software for EDIFACT messages has no affect on the adoption of XML-based invoices. E-invoicing has not only advantages, the risk to hide an invoice exist. However, some companies of the interviews use OCR scanner and automatic provision for paper invoices, therefore they see no additional risk or manipulation possibility for e-invoicing. The software or tool has to prove anyway the correct amount and compare it e. g. to the order. The acceptance and adoption of the ZUGFeRD standard is highly influenced by the business partner demand (external), as well as by the effort required for the implementation (internal). As from the expert interviews, critical success factors do not differ much from general ones for implementing e-invoices and standards. This can be explained by the lack of knowledge that the companies have and the novelty of the ZUGFeRD standard. Many companies have not heard about it and do not know how to handle structured data sets. Hence this research can confirm the already known critical success factors, expand them with specific ones and organize them in the TOE model (cp. Figure 4).

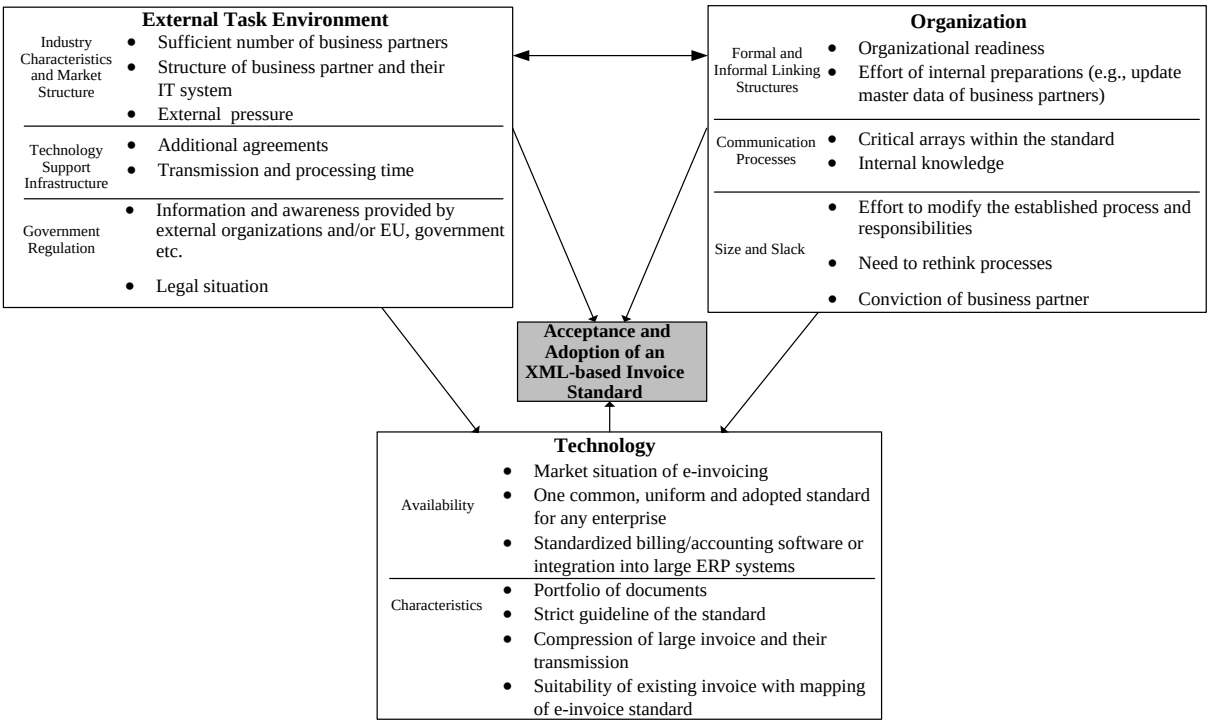


*Figure 4. TOE for the acceptance and adoption of an XML-based invoice standard*

It will be always difficult to change running systems and motivate companies to modify their processes if they feel no necessity or pressure to make changes. A solution with less effort but much potential of savings is needed to convince companies. The key factors are here: requests and information. When they receive many requests from business partners, companies will rethink their processes to satisfy customer and supplier demand. As soon as many of their business partners are using a uniform standard, the EDI users will be ready for another option for document exchange, the XML-based invoices. Adoption will occur in new business relationships, with SMEs, and with large companies. The migra-

tion can only proceed by a first implementation and adoption by non-users of EDI by replacing PDF and paper invoices.

# 5 Recommendations

Based on the results, recommendations for research and practice can be given to achieve successful adoption and implementation of XML-based standards in companies. The TOE model represents a first approach illustrating the critical success factors and the relationship among them. It supports companies by implementing an e-invoice process. For example, the master data of the business partner will need to be updated since the e-mail address for the invoice dispatch is required. To implement an e-invoice receipt, an e-mail address must be created and communicated to business partners. The creation of the e-mail post box is associated with the software development or extension. The software for the existing invoice processes could be modified, but the results show that an additional solution for the new implemented process is useful. The entire process must be examined and has to be integrated. The testing and validation of IS infrastructure is important. It is recommended that a pilot phase is set up with selected business partners to figure out the weak spots before modifying the entire business relationships. To keep the relationship perpetuate and also for the company's own requirements, a service package and a support hotline would be helpful to support business partners when questions or errors occur.

The main objective is to increase the acceptance of a new e-invoice standard to achieve a critical quantity. The more users a standard has, the more companies will adopt it. This is the biggest challenge at the same time. A standard always needs innovators who start to dispatch or even send requests for the invoice receipt. This can not only occur through company use; the public authorities should also be involved and should implement processes for e-invoices. An example for this is Directive 2014/55/EU to introduce an European standard for e-invoices with public procurement in the whole EU. When a company decides to use a new standard, business partners need to be convinced. The company can send a request via e-mail either for receipt or dispatch. With important and close business relationships, a personal appointment with the responsible employee should be arranged. The advantages and benefits for both sides must be presented, not just the request itself. For an XML-based standard, the standard has the potential to be a dominant standard for both e-invoices and other business documents in the coming years. It is a common and cross-industry standard and not a specific solution for only a single business relationship. It is also a standard for B2G transactions. In order to come up with a full cost-benefit analysis, a sufficient number of participating business partners is required. Hence, the request can already be used to find a decision by estimating how many invoices could be exchanged in this format. Companies could set up a portal solution as a possibility for those business partners who are not able to create data in XML. A further option is to provide software licenses for affordable software products to motivate the business partners to create their own e-invoices. Since ZUGFeRD has the advantage of a digital image, there is no need for a portal to provide the structured data. However, this critical success factor may also be supported by public authorities and the government by setting up a major information and awareness-raising campaign. When using a standard such as ZUGFeRD and its specifications, additional adjustments are not necessary. This may support the adoption of this standard. Some points need to be discussed and communicated, but they are not associated with much effort or cost. If companies would like to exchange their own XML-based standard, additional adjustments and testing are necessary and cannot be eliminated.

The critical success factors of an implementation that were identified within this qualitative study support the adoption and provide an overview for further research. When XML-based standards are established and a high adoption rate is achieved, the error-proneness will decrease. The same development took place for EDIFACT invoices due to testing and continuous developments. The internationalization is possible and the applicability throughout Europe is feasible. The largest disadvantage of EDIFACT messages is that agreements are required and that the implementation is associated with higher effort and investments. The ZUGFeRD standard has less room for interpretation and is developed for the implementation without any additional adjustments. Hence, these disadvantages will not

arise. The invoice standard can be used as a basis for other electronic business documents and represents a chance for a higher standardization than EDIFACT has reached up to now. Due to all these factors, XML-based standards have much potential to achieve a large market share and, in the foreseeable future, may completely replace established standards, as well as paper and PDF invoices. The migration will start with an increasing market share of XML-based invoices.

# 6 Limitations

The research was limited to German experts as this study focused on the exemplary case of ZUGFeRD, since it is the first XML-standard in Germany that has the potential of adoption. XML-based standards from other countries were not considered. But the research results can be applied to another national standard with a similar structure. However, in further research, other countries and standards must also be considered and the internationalization of the standards must be analyzed due to the advanced globalization. The adoption of these standards could be examined and compared to these research results. Then conclusions could be drawn and the TOE model expanded. The different legal situations and the lack of homogeneity are challenges for comparing e-invoice standards from other countries. Hence, the transferability of the results has not been analyzed. The enhanced TOE model contains the identified critical success factors. Further validation applying a quantitative-explorative study is advisable. Currently, only twelve expert interviews were held and interpreted. A sufficiently large sample should be examined. Further research can further deepen the results of this study. The TOE and the results can be used as a basis of other related topics of a successful adoption of e-invoicing standards.

# 7 Conclusions and Outlook

The aim of this study was to identify the critical success factors for the implementation of XML-based invoices. The case of the German ZUGFeRD standard was applied as no predominant other standard or governmental regulation of the market exist. Twelve qualitative expert interviews were conducted with the purpose to discuss the experts' experiences and opinion of the XML-based standard ZUGFeRD and the possible migration from EDIFACT where applicable. As is known from the results, the XML-based invoices have the potential to initially fill the gap between the invoices of a fully automated process within the EDI procedure and the remaining paper or PDF invoices. A greater competition, increasing digitalization of business processes, and environmental awareness may cause companies to rethink electronic invoicing and are therefore drivers for implementation. The expanded TOE model provides an overview of factors to be considered and brings them in relation. It supports practice as well as research within the implementation of an XML-based standard. In the coming years, a large market share of an XML-based standard must be achieved to install automated invoice processes. The potential of an adoption is seen and a successful implementation can proceed, but many companies are still waiting for the critical quantity and need pressure by the market or business partners. Future research must evaluate the qualitative results from this study with a quantitative survey in order to be able to generalize, reject, and extend them. Case study research can provide description, test or develop theories (Eisenhardt, 1989). Thus, case studies with companies' transition from EDIFACT to XML-based standards will be valuable to uncover further critical success factors and differentiate circumstances of small and large companies. The process of agreements, process and IS infrastructure change can be seen through by research in cases with SMEs first implementing e-invoices. This can provide more in depth recommendations for companies, interest groups, and governments in Europe. This theoretical research can support the practice and give recommendations for a successful implementation of an XML-based standard in companies. Considering that, networks between companies and researchers can help to promote the adoption of e-invoicing standards. For more detailed critical success factors special cases and specific industries have to be analyzed in further studies. However, the TOE model with the critical success factors gives a solid overview and advice for implementation of XML-based invoices successfully.

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