Initial Design of a Maturity Model for Electronic Invoice Processes

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Basic Information	BPMM	BPMMM	PEMM	SOGE
Source	Weber, Curtis, Gardiner, 2008	de Bruin, Rosemann, 2005	Hammer, 2007	McKay, Marshall, Prananto (2000)
Domain	BPM	BPM	BPM	e-business
Purpose of use	Descriptive, prescriptive, comparative	Descriptive, prescriptive, comparative	Descriptive, prescriptive, comparative	Descriptive, prescriptive
Maturity components	Five levels (initial, managed, standardized, predictable, innovating); different process areas for level 2-5	Five levels (initial state, defined repeatable, managed, optimised); dimensions (strategic alignment, governance, methods, IT, people, culture)	Four levels; Separation of five process enablers (design, performers, owner, infrastructure, metrics) and four enterprise capabilities (leadership, culture, expertise, governance)	Six levels (no presence, static on-line presence, interactive on-line presence, internet commerce, internal integration, external integration), seven dimensions (strategy, structure, systems, staff, style, skills, superordinate goals)
Requirement				
Overall aspects	●	◗	◗	◗
Management processes	●	◗	○	○
Improvement path	●	◗	◗	◗
Detailed IS aspects	○	○	○	●
All industries	●	●	●	●
All sizes of company	●	●	●	●
caption ○ not fulfilled		◗ partially fulfilled		● fulfilled

Evaluation and Discussion of a Maturity Model for Electronic Invoice Processes

Abstract

Dematerialization and automation of invoice processes are an essential opportunity for companies to pare down expenses, optimize administrative tasks, and in turn, increase efficiency and competitiveness. But electronic invoices are characterized by various software solutions, legal uncertainty as well as heterogeneous demands, know how, and information system infrastructure incompatibilities. A holistic map of electronic invoice processes must be presented, especially to demonstrate different levels of process integration and optimization. A maturity model for electronic invoice processes puts this into practice and provides companies with a tool to identify the current situation and derive recommendations for optimizing it. In this paper, such a model is designed theoretically and then evaluated with an explorative expert survey. The key dimensions are strategy, acceptance, and technology.

Keywords: e-invoicing, e-business, maturity model, business process management, e-invoice processes

1. Introduction

The digitalization of business processes is an essential method for cutting administrative costs, improving productivity in business processes, and achieving process transparency [7]. In order to improve efficiency and provide competitive advantages to companies, it is crucial to use information systems (IS) to support their business processes [1], [29] and processes with trading partners [30]. Administrative business processes, that provide low added value, should be kept to a minimum.

Although the invoice processes do not create value in the majority of cases, the electronic exchange of invoices is expected to generate significant economic benefits, especially if the electronic invoice (e-invoice) provides structured data for automated processing. E-invoices promise savings of both cost and time, because they reduce manual work, input errors, printing, and transport costs [7], [8], [29]. Migration from paper invoices to e-invoices within the European Union (EU) "will generate savings of around EUR 240 billion over a six-year period" [8]. Despite the obvious benefits, the market penetration of e-invoices in the EU is only about 5% for business-to-business (B2B) transactions [8]. This number is rather low. Companies have to deal with various solutions and technologies for electronic invoicing and processing. Other barriers to participation in electronic processes are the lack of awareness and the lack of adequate IS for process optimization, as well as high investment costs and heterogeneous demands of the trading partners [30]. Therefore companies need tools and methods to see the benefits and to cope with the barriers. They need support for implementing e-invoice processes, including identification of their actual situation, deduction, and prioritization of improvement. Maturity models fulfill these needs and support companies to determine the maturity level of their as-is situation in a specific area and indicate areas of improvement [1], [5].

The purpose of this research is to evaluate whether an electronic invoice processes maturity model (EIPMM) is useful, and also to develop the main components of such an EIPMM. Consequently, the following research question is addressed: *How can the maturity of electronic invoice processes be measured and what recommendations for companies can be drawn?*

A theoretical approach to maturity model conception, and results from an explorative survey with experts are used to achieve this research objective. In the first step, the theoretical background (section 2) and the research design (section 3) are introduced. In section 4, the development of the EIPMM, including the results of the expert survey, are presented. Finally, the discussion of the results and conclusions (section 5), and the limitations and an outlook on further research complete this article (section 6).

2. Theoretical background

2.1. Maturity models

Maturity models are conceptual models to evaluate and compare a company's maturity within a selected discipline [5], [21]. For example, software engineering [22], e-business [27], business processes [31], business process management [6], knowledge management [6], [16], and project management [4] are such disciplines. The maturity of organizational resources such as processes, objects, or technologies, are measured together with people's capabilities [25]. For these resources, dimensions are specified for structuring the analyzed discipline [25]. Normally, maturity models describe a desired and typical improvement process from the starting point to complete maturity [1]. The models imply a sequence of maturity levels [5]. Each level represents specific characteristics, competencies, and capabilities that must be fulfilled [1]. The lowest level is the initial stage, which is normally "characterized by a company having little capabilities in the domain under consideration" [1]. Higher levels stand for improved capabilities. After determining the as-is situation, companies can derive and prioritize recommendations for the next level from maturity models [2].

Maturity models can be descriptive, prescriptive, or comparative [5], [26]. Descriptive models assess the actual state of development and do not provide improvement perspectives. Prescriptive models derive improvement perspectives, and comparative ones enable a comparison with internal or external benchmarks.

Over the last several years, hundreds of maturity models have been developed by practitioners and academics [5], [21]. The importance of these models is still growing because they support companies in obtaining competitive advantage and identifying strategies for cost reduction, quality improvement, and reduction of time to market [2], [5], [21]. Therefore it is important that especially academic ones are developed methodically in a well-founded design [1], [5]. To be comparable, reusable and reliable maturity models require "detailed information about the application method, accessibility, reliability, and origin" [21].

2.2. The electronic invoice processes

Since the 1970s, companies have used electronic data interchange (EDI) to optimize their processes with trading partners [13], [24]. Business documents like orders and invoices are exchanged automatically in a standardized procedure by IS. The benefits of EDI are cost and time savings due to no manual data entry, avoiding redundant and incorrect data input, less administrative overhead, and immediate and universally available data [3]. But many different document types exist, including industry-specific or proprietary standards [13]. Therefore, trading partners have to agree on a common standard for data syntax and on semantics to structure the content of the documents. The implementation costs are high [3], and cover 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 running costs, lack of know how, and too few business transactions. EDI is therefore less established within small and medium-sized companies (SME) [3], [24]. According to a study about trends in electronic procurement [30], only a few large Swiss companies exchange business documents in a fully automated way with their suppliers. Mostly orders and invoices are exchanged electronically. For future projects the electronic exchange of invoices is a pivotal topic for the analyzed companies.

The invoice is the most important document exchanged between trading partners, including public authorities. It links the business processes order, delivery, payment, and accounting. But the invoice is much more than a commercial document. It also has legal implications. The invoice, including the self-billing (invoicing by supply receiving company), is 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. The taxable company has 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 [9]. This responsibility applies to paper and electronic invoices alike and is obtained by "business controls" [9]. These internal control mechanisms must guarantee "a reliable audit trail between an invoice and a supply of goods or services" [9]. According to Council Directive 2010/45/EU, the recipient has to agree to the exchange of e-invoices. Pre-tax deduction based on e-invoices was legally allowed for the first time in 2001. This event and the development of new technologies [13], [17] changed the landscape of e-invoices. A variety of solutions for e-invoice processes are available, but they differ in functional scope, level of process integration, and technical capabilities (cp. Figure 1). No formal rules exist for the e-invoice format. The invoice could be a structured format like EDIFACT or XML, or an unstructured format

Organizational layer	Business relation	E-invoice models	Software	Business process

	• Business-to-Business (B2B)
	• Business-to-Consumer (B2C)
	• Business-to-Government (B2G)
		• Direct model
		  • Seller-direct
		  • Buyer-direct
		• Consolidator model
			• ERP system
			• Invoicing/Billing software
			• Accounting software
			• Document management system
			• Workflow systems
			• Office software
				• Process integration
				  • Manual
				  • IS supported
				  • Fully automated
				• In-house
				• Outsourcing
				• Service provider

Technical layer	Transmission protocol	Transmission medium	Data format	Message standard
	• SMTP • FTP / S-FTP • HTTP/HTTPS • x.400 • AS2 • ..	• Email • EDI • Filetransfer • Service provider • Portal • ..	• Structured (EDIFACT, XML,..) • Unstructured (PDF, TXT,..)	• Neutral (EDIFACT, ebXML, OASIS UBL,..) • Industry specific (ISO 20022, GS1 XML,..) • Proprietary (SAP iDoc,..) • Country specific (Finvoice, OIOXML,..)

Legal layer

• Authenticity
• Integrity
• Legibility
• Storage format and storage period
• Corresponding legal requirements (e.g. for accounting)

Figure 1. Implementation strategies and options for e-invoice processes (following [17])

like PDF. Many different message standards exist for the structured format. E-invoices could be transmitted bilaterally between the partners (direct model) or through a service provider (consolidator model) [10], [17]. In both constellations there are alternate transmission mediums like EDI, email or a portal. Service providers often convert invoice data to the preferred data format [17]. Especially structured e-invoices generate significant economic benefits. Companies benefit not only from savings that are generated through an optimized processing of invoices but also from savings with regard to downstream processes. The invoice image and the invoice data are archived electronically. Therefore, companies can find invoices easily in their archive system by searching e.g. for invoice number, account number, or invoice amount.

3. Research Design

The development of a maturity model is inspired by design science research (DSR), which creates "new and innovative artifacts" that "define the ideas, practices, technical capabilities, and products through which the analysis, design implementation, management, and use of information systems can be effectively and efficiently accomplished" [12].

Following the practical guidelines for conducting DSR by Hevner's et al. [12], Becker et al. [1] introduce a procedural model for the development of maturity models that consists of eight phases: 1. Problem definition; 2. Comparison of existing maturity models; 3. Determination of development strategy; 4. Iterative maturity model development encompassing four sub-steps; 5. Conception of transfer and evaluation; 6. Implementation of transfer media; 7. Evaluation; 8. Rejection of maturity model. This approach was used to design the EIPMM, because it provides a systematic and structured design process.

It is recommended that a newly developed maturity model should be evaluated with the help of qualitative expert interviews [5]. For the design of the EIPMM, an explorative study with semi-structured telephone interviews was considered to be the best method to discuss existing and identify additional maturity model factors. Seven interview partners located in the EU were questioned as experts in the field of e-invoice. Four experts were selected based on their status as country information manager at e-invoice-gateway, a project of the European committee for standardization that aims to standardize electronic invoicing. Two experts were selected as representatives, who have partici-

pated in projects for implementation of e-invoice processes. Finally, a researcher from a European business school conducting research on e-invoice processes was selected as an expert.

Prior to the survey, the experts were sent an outline of the developed EIPMM and the questionnaire, which served as interview guideline. The interviews were recorded and then transcribed. The analysis of the interviews was carried out according to Mayring's qualitative deductive content analysis technique [19]. More specifically, the summarizing technique was considered to be the most suitable analysis method, since it enabled an extraction of essential statements from a large volume of text and presents them in a clear and accurate manner. The experts were re-contacted when clarification was needed.

In accordance with Mayring's summarizing technique, the transcribed interviews were reduced to the essential contents, first paraphrasing the text, then eliminating irrelevant or synonymous sections; in the following, similar paraphrases were bundled and generalized in order to conduct a further reduction. As a result, the reduced paraphrases were coded into categories in order to build up inferences (cp. Table 1).

Table 1. Coding example

Category 2: Importance of the factor "strategy"			
Expert	Paraphrase	Generalization	Category
1	Electronic invoicing does not much to do with strategy	Not much to do with strategy	No strategic decision
1	Electronic invoicing is not a strategic decision for many companies	Not a strategic decision	No strategic decision
2	Strategy is a basic necessity	Basic necessity	Essential factor
2	Strategy is a really significant issue and is the basis for everything	Really significant; basis for everything	Essential factor
3	The Factor "strategy" is very important, since electronic invoicing is a new topic	Very important	Essential factor
3	Electronic invoicing should be regarded strategically	Strategic consideration	Essential factor
4	"Strategy" is one of the most important factors	One of the most important factors	Essential factor
5	Strategy is very important; it is the key	Very important; key	Essential factor

4. E-invoice processes maturity model

4.1. Problem definition

A fully integrated procure-to-pay process chain provides essential cost savings [7]. Mostly large companies profit from it [18]. But for SMEs, the complexity of the e-invoice processes that results from the use of various solutions for electronic invoicing and processing (cp. Figure 1) is overwhelming. Furthermore the benefits for SMEs are small due to the low market penetration of e-invoicing [24], [27]. Other barriers for e-invoice participation are lack of IS and business strategy, high implementation and processing costs, and legal uncertainty [17], [29]. Often trading partners are not ready for e-invoices with regard to process and IS maturity, know how, or they are just not willing to adopt e-invoice processes [17], [23], [27]. Although the benefits are not as high as for large companies, SMEs can profit from e-invoice adoption, according to studies in Nordic European countries [15], [18], [29]. An important factor is a well-motivated and comprehensively designed implementation of e-invoice processes, combined with an awareness of the benefits [29].

The aim of the EIPMM is to represent a holistic map of e-invoice processes in companies, addressing relevant organizational, technical and legal components. These components have to be considered prior to implementation

and during operation. Companies can use EIPMM to identify the as-is situation and to derive recommendations for optimizing their invoice processes. The tool provides possible improvement perspectives for each specified dimension. It measures the maturity of invoice processes with regard to the company's ability to send and to receive e-invoices.

4.2. Comparison of existing maturity models

Actually there is no maturity model that explicitly addresses e-invoice processes. Because it is part of both e-business and part of a company's business processes, the e-invoice processes could be evaluated with existing models of these domains. Business process management (BPM) is a holistic organizational management practice [6]. Process maturity models that refer to general process quality or specific process types, and BPM maturity models, which refer to a company's BPM capability [28] were considered. The most popular maturity models for BPM [26] are the business process management maturity model (BPMMM) proposed by de Bruin and Rosemann [6], the business process maturity model (BPMM) issued by the open management group [31] and the process and enterprise maturity model (PEMM) designed by Hammer [11]. For the e-business topic, the stages of growth maturity model for e-business (SOGE) by McKay, Marshall and Prananto [20] was selected.

When companies implement an e-invoice process, they have to consider several factors, such as possible integration into existing business processes and IS architecture, convincing internal and external stakeholders, choosing a suitable e-invoice solution, and fulfilling legal requirements. The overall business objectives must always be taken into account. Conformity with applicable laws and regulations is quite important for the e-invoice processes. As a consequence, a maturity model for e-invoice processes should consider the *overall aspects*. It should also explain how processes can be implemented, including activities for planning, decisions, and controlling, as well as qualification measurements [11]. *Management processes* for the implementation of a new process have to be considered. Transparency is a very important factor for e-invoice participation. This does not only mean legal certainty, but also possible steps for process optimization. Therefore, the proposed model should include an *improvement path*. There are a lot of e-invoice solutions on the market, and they differentiate in the level of process integration and in technical aspects, especially internet technologies and capabilities for integration of internal and external partners (process automation). In the case of e-invoice processes, *detailed IS aspects* including information technology (IT) must also be taken into account. Finally, the model should be applicable across *all industries* and *all sizes of companies*.

None of the selected maturity models fulfilled all of the requirements for an EIPMM (cp. Table 2).

4.3. Determination of design strategy

When the existing maturity models are compared, it becomes clear that each model contains aspects that can be transferred to a maturity model for e-invoice processes. Therefore, a combination of the analyzed models into a new one is recommended.

The BPMMM seems to be the most suitable to serve as a starting point for the development of the EIPMM, although the BPMM and the SOGE fulfill more requirements. The dimensions and sub-dimensions of the BPMMM are partly or fully applicable to e-invoice processes. In addition, the staged structure, which enables a separate evaluation for each dimension, also provides the basis architecture of EIPMM. Two further models influenced the development process: the knowledge management capability assessment (KCMA) [5], which provides suitable maturity level labeling, and the e-business information system maturity model (EBISMM) [32], which provides additional aspects for developing the dimensions' content. The EBISMM was not considered in the comparison process because the model was in a draft state.

4.4. Iterative maturity model development

4.4.1. First iteration. EIPMM was developed in three iterations. The result of the first iteration was a draft of a primary architecture. The central characteristics and structure were determined. The initial model contained five maturity levels. The maturity levels were described in a top-down approach (cp. Figure 2). First the definition of maturity was determined and then recommendations for its measurement were developed.

According to the analyzed maturity models and the literature research on the e-invoice topic, special attention was paid to the benefits and barriers of implementation. Five interdependent dimensions were identified: strategy (BPMMM, SOGE), IS/IT and automation (BPMMM, EBISMM), internal and external acceptance (EBISMM), standardization (EBISMM), compliance. The s*trategy* dimension assesses to what extent e-invoice initiatives have been aligned with the overall business strategy and describes strategic decisions related to the implementation of e-invoice processes. The dimension *IS/IT and automation* measures the use and the progressiveness of IS/IT during implementation and operation of invoice processes, and to what degree the human interaction can be excluded using available IS. The dimension *internal and external acceptance* assesses to what extent the e-invoice processes have been accepted by internal and external stakeholders. The dimension *standardization* describes to what extent companies apply technical and economic standards. The dimension *compliance* describes the adoption of procedures that ensure legal conformity for the e-invoice processes. Depending on the company's business relations, international laws must also be considered. The first iteration was completed with a management-orientated description of the five maturity levels and the basic architecture of the EIPMM. For each level, the core objective was determined.
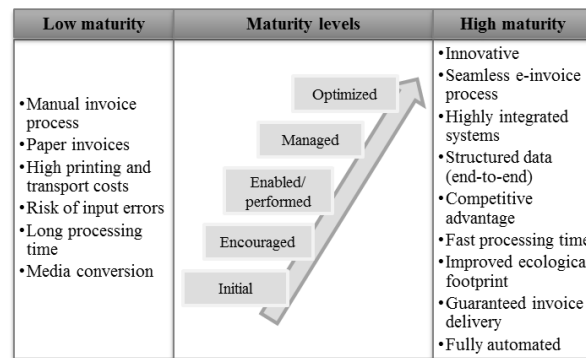

Figure 2. EIPMM iteration 1

4.4.2. Second iteration. The explanation of the dimensions and the managerial description of the maturity levels served as the basis for the second iteration. In this iteration, seven semi-structured telephone interviews with Euro-

Table 2. Comparison of maturity models

Basic Information	BPMM	BPMMM	PEMM	SOGE
Source	Weber, Curtis, Gardiner, 2008	de Bruin, Rosemann, 2005	Hammer, 2007	McKay, Marshall, Prananto (2000)
Domain	BPM	BPM	BPM	e-business
Purpose of use	Descriptive, prescriptive, comparative	Descriptive, prescriptive, comparative	Descriptive, prescriptive, comparative	Descriptive, prescriptive
Maturity components	Five levels (initial, managed, standardized, predictable, innovating); different process areas for level 2-5	Five levels (initial state, defined repeatable, managed, optimised); dimensions (strategic alignment, governance, methods, IT, people, culture)	Four levels; Separation of five process enablers (design, performers, owner, infrastructure, metrics) and four enterprise capabilities (leadership, culture, expertise, governance)	Six levels (no presence, static on-line presence, interactive on-line presence, internet commerce, internal integration, external integration), seven dimensions (strategy, structure, systems, staff, style, skills, superordinate goals)
Requirement				
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Management processes	●	◗	○	○
Improvement path	●	◗	◗	◗
Detailed IS aspects	○	○	○	●
All industries	●	●	●	●
All sizes of company	●	●	●	●
caption ○ not fulfilled		◗ partially fulfilled		● fulfilled

pean experts in the field of e-invoice were conducted. The objective of the interviews was to discuss the draft EIPMM.

The experts confirmed the usefulness of the model that demonstrates the complexity of e-invoice processes and corresponding process steps for optimization. Some experts pointed out that the starting point for the improvement process should be the level 0, meaning a complete lack of e-invoices. This is because the discussion with trading partners who do not use e-invoices is quite different from one with partners who are already using e-invoices. The latter are divided between the different levels of process integration (cp. Figure 1). The differentiation between managed and optimized was not clear, because the level managed already implies using an appropriate IS infrastructure and constantly optimizing it. Therefore, the only difference is that optimized refers to "having strategies". Some experts remarked that for them, the levels initial and encouraged are the same, because starting with something new also means encouraging the people to use it. But on the other hand, the experts highlighted that it is essential to differentiate more in the lower maturity levels than in the higher ones because these are currently the critical stages for companies. For the experts it was important that the names of the maturity levels represent the status quo.

One expert highlighted that for many companies it is not a strategic decision whether the invoices they send or receive are paper-based or in electronic form. The only overlap between the topic of e-invoice processes and strategy is the focus on not losing customers. This expert also viewed cost controls as an important but difficult factor in the implementation of e-invoice processes. Cost awareness is part of strategic decisions. The other experts confirmed that strategy is a key factor for the implementation process. One expert explained that strategy "is a basic necessity. Because everything starts from the strategy and as soon as you have a clear picture you can go forward with whatever details are required to implement this." Having a clear direction and the willingness to use e-invoices is very important. An important factor for some experts is cost awareness. Companies should analyze the costs for the invoice process. Only then it is possible to see the cost savings. One expert mentioned the environmental footprint of savings as part of a company's e-invoice strategy. Especially large companies are committed to sustainability.

The experts have a different view of the importance of the dimension *compliance*. For some it was important because the companies have to observe legal regulations, but others see it as a part of the selected e-invoice solution. However, none excluded this factor from the EIPMM. Furthermore, one expert explained that in Austria, nearly 50% of all companies are outsourcing there accountancy, especially to tax consultants. Like in Germany, the tax consultants are the representatives of the SMEs and therefore they are consulted on business decisions and strategies.

Next to the importance of tax consultants is the factor *acceptance*. Only one expert did not consider it to be a basic issue. This expert claimed that the use of e-invoices has nothing to do with acceptance, but is only a matter of being used to it. For the others experts, the internal and external acceptance were very important and represented two separate factors. External acceptance is required by law (cp. 2.2). Companies have to be able to convince their trading partners without having the market power to enforce the use of e-invoices. But internal partners also have to be considered and motivated.

Finally, the technical issues were evaluated by the experts. They have a different view of the importance of the dimension *IS/IT and automation*. For some experts, it is a key factor, because without suitable IS, companies are not able to benefit from reduced expenses. For others it is not important because there are sufficient service providers offering suitable solutions. The dimension *standardization* showed similar opinions. It may be an item for service providers and also for companies using an in-house e-invoice solution. Standardization is not an isolated issue for one company but it is an essential factor for the whole economy. Not only should standardization for exchanging e-inovices with trading partners be considered, but also the fragmentation and integration of IS within a company. All experts agreed that the technical dimension should be a part of the EIPMM.

4.4.3. Third iteration. In a third iteration the suggestions and considerations of the experts led to a modified architecture of the EIPMM (cp. Figure 3). The maturity path started at level 0, which was labeled *non-existent* (following PEMM) and ended at level 4, which was labeled *continuous improvement* (following KMCA). The labeling of levels 1 to 3 remained unchanged. The descriptions of the levels were adapted:

- *Non-existent*: No e-invoice processes.
- *Initial*: Top management recognizes the potential of an automated invoice process. Investments in suitable IS are made. Implementation of e-invoice processes faces some opposition from internal and/or external stakeholders and is associated with uncertainties with respect to legal requirements and lack of knowledge regarding standards.

- *Encouraged:* The invoice process is somewhat automated with available IS and tested with trading partners who are interested in e-invoices. The results are communicated to other trading partners, preparing them for the new way of exchanging invoices.
- *Enabled/performed*: Invoices are sent, received, and archived electronically. Various methods are established to achieve widespread acceptance of electronic exchange of invoices. E-invoice initiatives and activities increasingly support the achievement of the company's business objectives (e.g. reducing costs, improving ecological footprint, etc.).
- *Continuous improvement*: E-invoice processes are continuously improved by piloting innovative ideas and technologies. E-invoice processes reach their full potential, allowing seamless and fully automated exchange of invoices. The use of e-invoices aims at creating and maintaining competitive advantages.

Additionally the dimensions were modified according to the experts' recommendations. The experts proposed only three core dimensions, containing sub-dimensions for detailed structure (cp. Figure 3). The three maturity model dimensions are: *strategy*, *acceptance,* and *technology.*

Maturity Level		Strategy				Acceptance		Technology		
		Strategic alignment	Responsibility and accountability	Cost-benefit analysis	Policies and legal requirements	User acceptance	Trading partner on-boarding	Information systems	Technical standards	Integration and automation
0	Non-existent									
1	Initial									
2	Encouraged									
3	Enabled/ performed									
4	Continuous improvement									

Figure 3. EIPMM iteration 3

Following the experts' suggestions, the dimension *compliance* was reassigned to the dimension *strategy* and renamed to *policies and legal requirements*. This sub-dimension assesses whether a company has adopted procedures that ensure that the e-invoice process conforms to national and international laws. It also measures compliance with internal policies and regulations. In addition, the experts recommended two further sub-dimensions, namely *cost-benefit analysis* and *responsibility and accountability*. The *cost-benefit analysis* should address the company's cost awareness. It deals, for example, with the calculation of costs caused by both paper-based and e-invoices to enable analysis of the cost savings that are achieved with automated invoice processes. The third sub-dimension assesses the involvement of top management and the responsibility and accountability of all relevant stakeholders to the e-invoice processes. A mature level means that not only management feels responsible for the e-invoice process, but also the executing staff. Finally, the overall business objectives are taken into account and the e-invoice process has to be aligned with them. The sub-dimension *strategic alignment* measures the planning of process improvement, the linkage between strategy and e-invoice processes, the definition of process architecture, key performance indicators, and key customers and stakeholders [5]. In this context, a company has e.g. to decide between using an in-house solution and outsourcing. The dimension *internal and external acceptance* was divided into two sub-dimensions (*trading partner on-boarding* and *user acceptance*) and was clustered to the new core dimension *acceptance*. The sub-dimension *user acceptance* refers to the acceptance of exchanging and processing e-invoices by all internal stakeholders. This implies being aware of the benefits and using electronic documents for document exchange within the company, as well as understanding the complexity of the topic e-invoice. Sales managers are able to promote the electronic exchange of invoices to the customers. The sub-dimension *trading partner on-boarding* assesses the willingness to exchange e-invoices by the company's trading partners. There is the persuasion strategy, meaning, that trading partners are shown the benefits and are convinced to participate. The contrary strategy is to force the trading partners to participate. The last core dimension is *technology,* which includes the sub-dimensions *integration and automation, technical standards,* and *information systems*. The sub-dimension *integration and automation* measures the level of automated exchange and processing of e-invoices. The whole procure-to-pay cycle should be considered. There are different maturity steps for processing e-invoices, starting at the manual processing, over IS

support for capturing invoice data from PDF invoices, and finally full automation. Closely linked to this sub-dimension are *technical standards*. Without standards, automation is not possible because trading partners' must be able to interact with one another without manual intervention. And finally, the sub-dimension *information systems* assesses the IS infrastructure for e-invoice processes and determines whether the current IS is capable of generating, transmission, and receiving e-invoices. It evaluates whether there is a system to archive documents electronically or whether there is a workflow system for electronic approval and circulation of documents within a company.

5. Discussion and Conclusions

There is a large number of maturity models, but often these models have no empirical foundation [5], [26]. That is closely linked to the lack of a systematic design process and the documentation of relevance and motivation [1], [5]. Therefore, the focus of maturity model research is on developing procedural models for their design [3], [5] and determining design principles and classification schemes [21], [26]. The design, evaluation and testing of maturity models should have a methodical foundation. The documentation and presentation of the designed model enable users to apply and generalize it, but should also prove its suitability for application. The design process of the EIPMM is shown here and is based on the procedure models of Becker et al. (2009) [1]. The components of the EIPMM resulted from literature research and the evaluation based on an explorative expert survey. In addition to the systematic approach, the relevance of an EIPMM was evaluated. All experts confirmed the usefulness of the model. They highlighted that it is a suitable tool for management to understand the complexity and the different possibilities for e-invoice solutions. But it is not the solution for the widespread dispersion of e-invoices, which is the aim of the EU commission [8].

In addition to the relevance of an EIPMM, the maturity measurements of e-invoice processes – in accordance to the research question – are identified and recommendations are derived. The maturity of e-invoice processes are measured by the main dimensions strategy, acceptance, and technology and by five maturity levels (0: Non-existent, 1: Initial, 2: Encouraged, 3: Enabled/performed, and 4: Continuous improvement). Further, the dimensions include a set of sub-dimensions (strategic alignment, responsibility and accountability, cost-benefit analysis, policies and legal requirements; user acceptance, trading partner on-boarding; information systems, technical standards, integration and automation). In the context of the EIPMM, companies could decide which maturity level fits best for each dimension. It also shows the dependency on other business processes with regard to integration and automation. For example, it shows whether there are links between the IS for ordering, invoice processing, accounting, and payment, and also whether there is an IS based workflow for invoice approval. The EIPMM provides guidance on what e-invoice processes are, what the benefits are, what kind of technology must be available, and what the overall aspects are. The EIPMM also shows that the human factor is important. Internal and external partners have to be convinced. But e-invoice processes are not core processes, but supporting ones. Especially, SMEs have normally no intrinsic motivation to send or to receive e-invoices. Therefore companies, that actually do not use e-invoices, must be convinced and the "e-invoice process" must be sold to them, showing how to start, what the benefits are, and why they should invest in it. With e-invoice processes, it is essential to consider the strategic alignment, because the digitalization of the invoice process often requires high investment in IS solutions and infrastructure. Companies have to assess the benefits against both the expense and the long-term strategy. As a consequence of a lack of strategic alignment, companies are unable to realize benefits from investments in IS.

Maturity models support companies in identifying strengths and weakness of a specific domain and in developing and improving this domain. But being a model, it is possible that the reality is oversimplified and that "the potential existence of multiple equally advantageous paths" are neglected [26]. Therefore maturity models should focus on factors for development and improvement [26] and demonstrate the characteristics for deploying high-performance processes [11]. According to the experts, the EIPMM is a valuable tool, not only for evaluation of internal capabilities, but also for discussions with trading partners. Although companies have a high maturity level of e-invoice processes, they must consider that actually only a few invoices are exchanged electronically within the EU. Therefore, they must also provide an invoice process for paper based invoices. Furthermore, the infrastructure of a companies' trading partner must be considered. When the trading partners are very heterogeneous with regard to technical possibilities and capabilities then the company must analyze and evaluate the different requests independently of its own maturity level. Solutions with high level of integration are often not profitable when only a few invoices are exchanged electronically. Consequently, there are a lot of factors which influence the widespread dispersion of e-invoices. The maturity of e-invoices processes is only one of them.

All in all the EIPMM shows companies that the e-invoice participation is a process with different levels of integration and automation. Companies have to select the solution that fits best. Not all companies benefit from having fully automated invoice processing. There are various stages of process integration, depending on the invoice type: paper invoice, e-invoice as an unstructured attachment to an email, structured data received by invoice scanning solutions, and e-invoices in structured formats. The benefits for a company depend on the starting point of maturity and the planned level of maturity. Invoice processing is a complex process with a lot of stakeholders and factors to be considered. There is no single "e-invoice" but a lot of different versions. EIPMM demonstrates these specific coherences by extending existing maturity models.

6. Limitations and Outlook

The EIPMM is currently not complete. The dimensions and maturity levels of the EIPMM, as well as its usefulness, were evaluated. But in this stage an easy application for companies is not possible and no statements about generalization of the EIPMM's application concerning different company sizes or industry sectors can be made. Although only a small number of experts were interviewed, the survey has revealed that a maturity model for e-invoice processes is useful and that each country faces different approaches. After completion, the EIPMM should be classified [21], [26]. The next iteration for developing the EIPMM is to refine the measurements in each dimension with regard to sub-dimensions and maturity level. Good/best practices for application, quality, and effectiveness need to be determined. Furthermore, the objective of each section should be provided, together with the possibility of better determining the company's status quo. The first step is to collect input from the expert interviews and from a further literature research. Afterwards a validation of the developed model needs to follow. Not only should the validation prove the model and its applicability across different industries, it should also reveal the maturity of the companies with regard to the e-invoice processes. After that the transfer and evaluation concept has to be determined, followed by the implementation of transfer media [1]. The EIPMM should be provided to the previously defined user groups in a suitable manner. Finally, the EIPMM should be evaluated against achievements of the previously defined objectives [1]. For EIPMM, the objectives include explaining the complexity of the e-invoice processes and providing a map for trading partners to evaluate a suitable solution for exchanging e-invoices. Furthermore, companies should be able to identify the as-is situation, including cost drivers and should also be able to derive recommendations for optimization.

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