Introduction of a Contract Management Workflow at codecentric AG

Bachelor Thesis - Interim Report

Submitted by Pia Erbrath

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Glossary

Notation	Description
API	Application Programming Interface Defined interface for the communication to the tool or software that provides the interface.
app	Application Software An application for all kinds of computer, in this document specific for mobile devices.
eIDAS	Regulation from European parliament and council regarding electronic identification and trust services for electronic transactions in the internal market and repealing Directive 1999/93/EC.
SDK	Software Development Kit Collection of APIs, documentation and libraries for software development with specific functionality provided by the SDK.
smartcard	A card with a chip on it, that can stores data e.g. biometric data or certificates. It compares access data like a PIN with input data and only if the data matchs each other, the user is identifies and/or the rest of the data stored is accessible.

Acronyms

Notation	Description
AES	advanced electronic signature.
BGB	Bürgerliches Gesetzbuch(Civil Law Code from Germany).
BS	biometric signature.
cc	codecentric AG.
CD	CenterDevice.
CMS	contract management system.
DS	Document Solution.
EEA	European Economic Area.
ERP	Enterprise Resource Planning system.
ES	electronic Signature.
EU	European Union.
GTCT	general terms and conditions of trade.
HR	human resources.
IT	Information Technology.
PDF	Portable Document Format.
PKI	public-key infrastructure.
QES	qualified electronic signature.
SES	simple electronic signature.

Chapter 1

Introduction

This document is the report about the bachelor thesis of Pia Erbrath. The author is a student from the Fontys Hogeschool of Techniek en Logistiek at the site in Venlo, Netherlands. The following chapter gives an overview about the context, the company the bachelor thesis is done and the document structure.

1.1 Context

At the end of the study, which have a duration of eight semesters, a bachelor thesis need to be created. This is to be done in a company, to get «real»life experiences and to can apply his knowledge gathered during the study.

1.2 codecentric AG

Codecentric AG (cc) was founded 2005 in Solingen and is focused on the agile development of software and the usage of innovative technology (codecentric AG, 2018b). The products distributed by cc are:

- Services in Information Technology (IT)-Technology

- Consultancy service for software and performance

- Software development

- Training and workshops for developed software

At the moment cc have fifteen sites in Europe and about 400 employees. Also, cc has two subsidiary start-ups CenterDevices (CDs) and Instana (codecentric AG, 2018a) and a lot of partners e.g. Scrum.org or elastic (codecentric AG, 2018c). That leads to many competences with new technology like *Internet of Things*, *Big Data*, *Continuous Delivery* and more. A lot of customers from several areas and size use these competences and products.

In Solingen is the head quarter of cc with space for 200 employees. Different departments are located her, like Finance, Sales, Document Solution (DS) and a team CD. The bachelor thesis is executed in the department DS, which has currently a size of around fifteen members.

The project is for the administration from cc. That includes mostly the departments Finance, Sales and Human Resources, but also other departments could be influenced through the project.

1.3   Document Structure

Inside this section the document structure will be explained. Behind the introduction first the project assignment is described followed by the project management. Next an analysis of the current state is made. Then the requirements of the new process is defined. And finally a conclusion with a lookup is given.

Chapter 2

Assignment

This chapter gives an overview about the bachelor thesis project. Therefore, the problem ans the assignment are explained, the scope and the phases are defined and finally the motivation behind the project is documented.

2.1 Problem Description

The first plan was to create a contract management system (CMS) for the customer Wacom, which produces among others the technology and hardware for mobile devices and Windows operating systems that can be used to make graphics or to sign documents (Wacom, 2018b). But currently they develop a new SDK of their app *sign pro PDF*, which allows the signing of documents on a mobile phone with their pen hardware technology(Wacom, 2018a), that will be finished earliest in July 2018 and the CMS should be build on that SDK. Due to the fact that the bachelor thesis project ends at the beginning of July 2018 it is not doable at all.

Then a contact to the Finance and Sales department of cc was made. They currently want to set up a new Enterprise Resource Planning system (ERP), because the old ERP does not fit the requirements anymore. One big aspect for them is to reduce the paper work and automate or simplify several processes regarding making quotes, orders and invoices, starting projects and storing data at only one point for all departments. At this point a CMS would make sense that can interact with the new ERP.

2.2 Assignment Description

The idea of the task is to introduce the electronic Signature (ES) with a general usage by cc. Currently they use the ES partly, but not in all areas possible. This means that all possible contracts and quotes should be signed with the ES and stored digital, so that the paperless office can be created. Included in the task is the creation of a workflow, that automates the process of subscribing regrading the signing guideline of cc so that cost for managing could be reduced and the response time is increased.

In the case that there is time left the aspects of creation of contracts and quotes based on templates and customer depending on information could be added to the workflow and the archiving of contracts regarding the regulations based from the governance and cc. For the realization already existing tools should be used in the best case.

2.3 Scope

The focus is the creation of a process for the electronic signing of documents. Additional the writing of the bachelor thesis is part of this focus. Only in the case that time is left until the end of the internship additional functionality is to be implemented like achieving the signed documents and the template creation of contracts and quotes. The thesis is concentrate on these aspects of a CMS, because the development of a complete CMS will take more time than given through the internship.

Out of scope will be all other document types than quotes, contracts, order and order confirmation. They will be focused after the internship.

2.4 Phases & Products

There are five phases in the project:

1. Project planning:

2. Analysis of the current situation and the requirements needed

3. Designing of a new workflow

4. Implementation and testing of the workflow based on the defined scope

5. Finalize bachelor thesis

Inside these phases several products should be delivered. They are listed below:

- Project plan

- Documentation of the current situation

- Research about ES and tools that could be used to sign documents electronically

- A documentation and implementation of the new workflow to sign documents digital

- A report about the bachelor thesis (this document)

2.5 Motivation

There are different motivation aspects behind the project. First of all is the reducing of work. When the steps of creating, signing and archiving of documents is automated less employee need to work in this area. Next the response time gets faster regrading the concluding of contracts. And finally the guidelines of cc must be complied by the employees due to the fact that there is an automated process based on the guidelines.

Chapter 3

Project Management

For the managing of the bachelor thesis project different aspects need to be taken into account, like how to do the project in which time and how to ensure a good quality of products. These things are explained in this chapter.

3.1 Approach

The project in general is done in a waterfall model, based on the phases explained in section 2.4. But the internal working of the implementation and testing phase will be done in an agile way due to the fact that the functionalities will be implemented through scenarios, also called use cases.

The usage of an agile way helps to develop a product that fulfill all requirements specified and is maintainable. This happen as a result of the continuous implementation of additional functionalities in existing basic functionalities.

For the agile way iterations, also called sprints, are planned with one use case, which is selected together with the leader of the department DS and one member of the department sales.

3.2 Time Planning

The project implementation will be done in an agile way, that means for the implementation of the worflow user stories will be created, and they need to be fulfilled. The preparation that needs to be done before are made inside a waterfall model. A general time planning can be seen in table 3.1.

3.3 Quality Assurance

The project consist out of three major deliverable categories that have different quality approaches. They are listed below:

1. Documents:
   To create qualitatively high documents two techniques are used. On the one hand the writing is done with a tool that checks the orthographic and the grammar and on the other one is the document reviewed by other persons to check the logic and understandability.

Phase	Week	Activity	CW
1	1-4	Project planning, Topic introduction	5-9
	4	Research ES	9
Milestone I	06/03/2018	Project Plan	10
1	5,6	Analysis current state & requirements	10-11
2	7	Research tools	12
Milestone II	27/03/2018	Midterm report	13
2	9	Research tools	13
Milestone III	05/04/2018	Midterm presentation	14
3	10,11	Designing new workflow	14-15
	12	Testing design	16
4	13-17	Implementing worflow	17-21
	18	Testing workflow	22
5	19	Final preparation of report & presentation	23
Milestone IV	12/06/2018	Final Report	24
Milestone V	?	Final presentation	?

Table 3.1: Time planning of project

2. Diagrams:
   In the analysis and the design phase diagrams need to be created. First of all the used diagram types have defined standards, these standards must be fulfilled. Therefore, exists tools that can handle the checking. This will be used. Additional the logic will be checked by persons that currently work (or will work) in the processes visualized in the diagram.

3. Implementation:
   For the implementation different use cases will be created, that need to be implemented. The checking will be that they can be executed without errors. Furthermore, if code is created, it will be done based on the defined standard of the used programming language and test driven.

The created results will be regular presented and discussed with involved persons. That leads to the possibility to avoid big problems, cause of their early detection.

3.4   Deliverables

At the end of the internship a working process should be implemented. That also needs to be documented in the sense that other developer can maintain the implemented process. Also, a user manual should be created for the user of the process.

3.5   Risk Management

Inside this section already find risks will be presented in the figure 3.2. They could be changed through the time, cause of currently unknown situations.

#	Risk	Description	Trigger	Precaution	Probability	Impact	Status
1	Time Issue	Long absence from project leads to time problems to finish tasks.	Illness, accident, holidays, to less project boundaries, ...	Estimate more time than expected (time buffer), clear scope definition	7	6	Occurred
2	Legals	Legals influence the requirement of a project and need to be fulfilled otherwise it could results in punishments	New laws from governance/ European Union (EU)	Collaboration a lawyer / person with knowledge about laws, Make research about laws regarding used technology	2	7	Open
3	New technology / programming language / API / SDK / framework	The usage of new technology results in unknown problems that could not be solved with that technology due to the fact that requirements could not be fulfilled	Not enough knowledge about the used technology	Good research about technology, usage of tools knowledge already exists in company, estimate more time	3	3	Open
4	Communication	Cause of the influence of many parties on the project, communication problems could occur, like meetings invitation, incorrect requirements, ...	Missing or incomplete communication	Research about all involved parties, keep them informed and make regular meetings	3	3	Open
5	ERP	Currently the Backoffice/Finance/HR want to switch to a new ERP, but at the moment it is not clear which one will be used. Some steps of the new workflow depend on the ERP, so that the workflowcould not be implemented at the end of the project.	Late decission, no possible to fit worklfow to the ERP	Communication, get information about the current state, be participated with the tests	5	5	Open

Table 3.2: Risk Register

Chapter 4

Analysis of the Current State

In the following chapter the current creation and signing process of quotes and order confirmation for customer projects are described.

At the moment exist no contract management systems. Cc has a process established that fulfills partly the signing guideline of the company. In the appendix A the business process from the current state are visualized. They will be described in the section 4.2. But before the signing guideline will be described.

4.1   Signing Guideline

Cc has a signing guideline, which is for the thesis summarized in table 4.1:

Position	Amendment	Document Types
Governing Board	-	All documents can be created within cc.
Procurator	ppa	All employees belonging to this group have the procuration to sign all documents with the same rights as the governing board.
Site & human resources (HR) manager	i.V.	The group has a general authority to sign documents, but there are a few exceptions, where they need to sign together with one from the governing board or the procurator. One important point is that the project contract and partner quote with a sum less than 50.000 €can be signed without them, everything above need to be signed together with them. There a more exceptions, but they are only for specific cases, that will be explained below.
All other employees	i.A.	This group is allowed to create quotes and sign them if this belongs to their tasks and the sum of the quote is not higher than 50.000 €.

Table 4.1: Summary Signature Guideline of codecentric AG

The exceptions for the site and HR managers are the following: all topics regarding the area loan and dept, lease contracts, buying and sale of cars, every type of contract that needs the handwritten signature and juristic acts.

The guideline defines strict regulations. Important is that there are some conditions regarding the type of document and the amount of a sum of contract/quote. This need to be known by the persons which want to sign a document. Also, additional knowledge is required about the information who has which position.

4.2   Business Process

First of all the involved user groups of the business process are explained, next the general process is briefly described followed by the concerning subprocesses.

Involved User Groups

Currently the following parties are involved in the business process:

#	Role	Description
1	Customer	The user group want to have a product/solution for a problem. In this process the aim is to get a project or order from the customer. So he needs to be satisfied.
2	Sales	The user group creates the quotes and will process the orders/projects if the quotes were accepted by the customer.
3	Backoffice	This actor group coordinates the incoming orders and keep track of the completeness for all documents needed for the order.
4	Executive Board	This group is only involved inside the process if the sum of a quote is higher than a defined amount (defined in the signing guideline). Then one of them need to sign/agree on the document.

Table 4.2: Roles Involved in the Old Business Process

Terminologies

At cc different terminologies are used, which are also used to explain the business process. To get an understanding of them they are listed here:

- Quote:
  Is a document in which cc gives the customer an overview about the approximated work, needed software and hardware and costs to their requested project. This document type is divided in two subcategories. This is important to distinguish between them, because the creation of them is different. In the following they will be explained:

  1. Simple Quote:
     An uncomplicated quote, which has only a few listings of needed Software and Hardware and estimated working and their prices. It is always based on the general terms and conditions of trade (GTCT).

  2. Complex Quote:
     A quote for a bigger project or company. Inside this document a lot of explanations about tasks and topics are placed. Also, the sum is mostly higher than 50.000 €and can have regulations regarding the paying of the sum. Furthermore, this type may be have different legal foundation than a simple quote. Moreover, could it be that inside this project extern employees are involved and the quote explains the conditions of this situation. In general with this quote type more interactions with the customer is required.

- Order:
  A document send from the customer to cc, that has as content the information which quote is accepted. Furthermore, it need to be signed by the customer

- Order Confirmation:
  This document is sent from cc to the customer with the information that the order is accepted and will be processed from a team of cc.

General Process

The general process is visualized in figure A.1. Mainly involved are the sales and the backoffice department. The only interaction with the customer is to exchange documents and information, which are needed to create the documents for the possible projects. There is also a clear division of tasks. The Sales is responsible for the quotes and the backoffices for coordinating and set up the requirements to start the working on the orders coming in based on the quotes.

The used technologies and tools in this process are mainly the current ERP Scopevisio, Microsoft Word and Google Docs, sometimes DocuSign is also used. With the first one the basic information of the document is created and maintained, the simple quotes are generated out of it and all documents are stored inside based on a defined structure. With Microsoft Word and Google Docs mostly the more complex quotes and the contracts are created. The employees can choose which one of the two tools they will use. DocuSign is an online tool that provides functionality to sign documents electronically.

Subprocesses

In the general process several subprocesses are mentioned. Each of them will be described.

The first subprocess is the creation of the quote visualized in figure A.2. This process is placed in the sales department. They use the ERP tool Scopevisio to generate the metadata of the quote and depending on the category of the possible project either a simple quote is genera

In the figure A.3 the second subprocess is shown. It visualizes the signing process of a quote. The document need to be signed regarding the signing guideline of cc. An overview is given in the section 4.1. At a certain amount of the sum the governing board need to sign the contract additional. At the moment the signing can be done in two ways. First manually on paper and then send the contract doubled to the customer with a letter or scan the signed contract and then send it with a mail to the customer. Sometimes it happens that this step is ignored by the employees.

The next subprocess the approving of the order from the customer, presented in figure A.4. The backoffice checks if the order is conformed to the stored quote in Scopevisio. In the case there are some inconsistencies they will be removed. Therefore, it could be that the customer needs to be contacted, which is not visualized in the diagram. Finally, the order is approved.

The last subprocess is the setup of the order processing. This process is presented through the figure A.5. First the backoffice informs the project manager that they successfully agreed with the customer. At this point starts a next subprocess. This is shown in figure A.6. In the cases that additional licenses or hardware is required, that will be ordered and the invoices and delivery tickets added to Scopevisio. Then it goes back to the previous process.
The backoffice identifies the person(s) which should process the order and creates for it/them a task ticket on the Jira, a tool for tracking projects and their progress. In the case that the employees are unknown, the project manager is requested to determinate them. Next all involved employees get the information about the ticket and the processing of the order can be started.

4.3   Issues & Problems

At the moment there are several issues and problems with the process. The major problem is that the most documents will be signed manually. This leads to several others facts:

- The signing process can take a lot of time:
  Due to the fact that some documents type need to be signed additionally from one of the governing board or a procurator and that there are fourteen sites without a person having this status, the document need to be sent to the headquarter of cc in Solingen. Therefore, three options exist:

  1. Sign the document, scan it afterwards and send it via mail to the headquarter and back to the site, which makes a lot of effort and manual actions.
  2. Sign the document and send it with a letter to the headquarter and back to the site, which may take days or weeks.
  3. Make a combination of the previous two possibilities.

  The same situation occurs with the customer interaction, as can be seen in the diagrams in the appendix A. Also here the three previous described possibilities exist.
  Additional it could happen that no person need to sign is not available in the headquarter and it may take some time till he can sign the document.

- Not all documents will be signed correct regarding the signing guideline:
  Sometimes the situation occurs that documents are not signed regarding the signing guideline, for example a missing amendment, or a wrong person signed the document. This is because of the complex process and not controlled actions. The controlling is mostly not doable cause the persons may responsible for that have enough to do with their other work.

- Not all documents will be signed:
  In many cases happens that documents were not signed because of the too much effort it needs or the employees do not know that they need to sign the documents.

In some cases already the online tool DocuSign is used to sign documents electronically. But at the moment only a few people can upload the to be signed documents. This leads to the situation that they need to coordinate the signing process in the case it should happen electronically. Furthermore, there is the issue of the manual placement of placeholders for elements the signer need to fill in, like date, place, name and signature. Moreover, the persons need to sign the document need to be specified before sending it. In the case an additional person from cc need to sign the document, based on the regulation from the signing guideline, also they need to be specified. If the selected person do not recognizes the request of signing, it also can take time to get the signature.

Furthermore, a problem is the achieving of the documents. At the moment this is done for the most documents electronically. Therefore, the documents need to be scanned and placed in the electronic archive. In the case the document was signed electronically it need to be downloaded from the tool DocuSign and placed in the archive. These steps make a lot of effort and take time could be used for other tasks.

Another problem is the creation of the documents. In the quote generation process often formal mistakes are inserted like an incorrect period of payment, especial if the customer have a different arrangement with cc as the GTCT. Additional the documents have a different layout, that leads to the issue of an inconsistent corporate identity towards the customer and the outside world.

Finally, there is the problem, that the signing guideline is outdated and not practicable anymore in some parts for cc. At the moment the staff of cc follows the practical way, which is official not allowed.

Chapter 5

Requirements for the New Process

The new business process should solve the problems explained in detail in section 4.3. But additional there are more requirements to the new process in the technical and formal area. Inside this chapter first the aims of the new process are explained. Next the requirements are described and finally a sketch of the new process presented.

5.1 Aims

The company cc hops that the new process can solve the problems they currently have. Therefore, they defined the following aims that should be reached with the new process:

1. Satisfy the signing guideline in the regular working process.
   In the future all documents should be signed regarding the signing guideline. It should not be possible to send an unsigned or incorrect signed document to the customer. Furthermore, the employees should not think about what they need to sign with which amendment. The system implemented the new business process should predetermine the needed fields to be filled in with the information of the according content.

2. Automate the achieving of documents.
   All documents should be achieved regarding their content and relation to other documents. This should leads to a clear structure, which can be fast understand and simple to use for the employees working with that documents. At the end the amount of work for searching and achieving should be reduced and the processing of other tasks should get faster cause of the sorted achieve.

3. Reduce the manual work by creating and signing of documents.
   The interaction with the sites of cc should get faster and simpler. Also, the creation of the documents should be done based on templates to reach a corporate identity within all documents and reduce the formal mistakes inside of them. Moreover, the manual work should be reduced. In the best case the system automatically fill the standard information correct in and add the fields for signing without any help of the human.

4. Reduce the usage of paper in the office.
   Due to the fact that all contracts and belonging documents are either stored electronically or need to be achieved in the headquarter at Solingen. This leads to situation that the documents when the achieved electronically will be disposed properly or send with the postal way to Solingen and placed there in the

physical archive. In the case that this will be done mostly everything electronically, the costs will be reduced for the properly disposal, sending and the maintenance and the place of the physical archive.

The result should be that cc can work more effectively so that the reaction time by customer requests can be speed up and unnecessary and error-prone work can be reduced due to automation.

5.2   Requirements

For the new process a few requirements need to be fulfilled to reach the aims defined previously and the acceptance of all employees and customers of cc.

1. Defined standard process:
   To keep it simple to use there should be standard process. This is also easier to control and the teaching of it is always the same. Moreover, exceptions should be avoided, because that leads to confusion, old problems and mistakes.

2. Accepted document formats:
   At cc currently the following document formats are used to create and store documents: Portable Document Format (PDF), Microsoft Word and Open Office Writer. They should also be used in the new process, to avoid problems with the usage and installation of the new software for document creation. Additional it should not be to complicated too create new documents.

3. Transparency about signing guideline:
   Through the new process the signing guideline should get more transparent for the staff of cc. This means during the creation of a document the employee should get the information if he need to inform a person from the executive board. Moreover, by the creation of the new process clear terminology definitions should be created to avoid communication and interpretation problems between the staff and the different departments of cc.

4. Fulfillment of the signing guideline:
   The new process should make it simple to fulfill the signing guideline. In the best case all persons need to sign, based on the signing guideline should be automatically invited to sign in the correct order. This functionality requires an automatic insertion of the needed data fields like date, place and signature. With the automation it is ensured that the signing guideline is always fulfilled due to the fact that the creator of the document do not need to know who had to sign from cc.

5. Certain legal standard:
   Another requirement is that the new process need to fulfill legal standards. This includes aspects of data protection, regulations regarding electronic signature and security aspects. Additional it need to keep care that the standards from the customer, partner and the company itself need to be satisfied.
   As ES should at least the advanced electronic signature (AES) be used, because it makes possible to ensure authenticity and integrity as can be seen in appendix B.

Beside the major requirements listed above there are some nice-to-have features like one design for all documents to get a corporate identity in them. Furthermore, it will be nice when the documents could be sent about one mail address specified per responsibility like quotes and order confirmation with *office@codecentitc.de*. This ensures the correct receiving of an answer from the customers. The implementation establishes a simple response functionality for the customer, because the German government determine, that the authenticity and integrity of a received document with mail need to be guaranteed.

Chapter 6

Conclusion

At the moment there are several problems by cc in their contract management process. They do not fit their process to the growing company. Additional they tested new technology with the ES, but did not introduce it official. The biggest issues are the manual steps need to be done and the violation of the outdated signing guideline.

With the defined requirements for the new process a basis is created which gives the possibility to automate steps and introduce the ES official. The next steps in the project will be the designing and implementation of the new process. It will not be possible to implement all functionalities. The main work will be the introduction of the electronic signing of the documents. Therefore, a research will be done about tools for signing them.

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Appendix A

Business Process Models of the Old Process
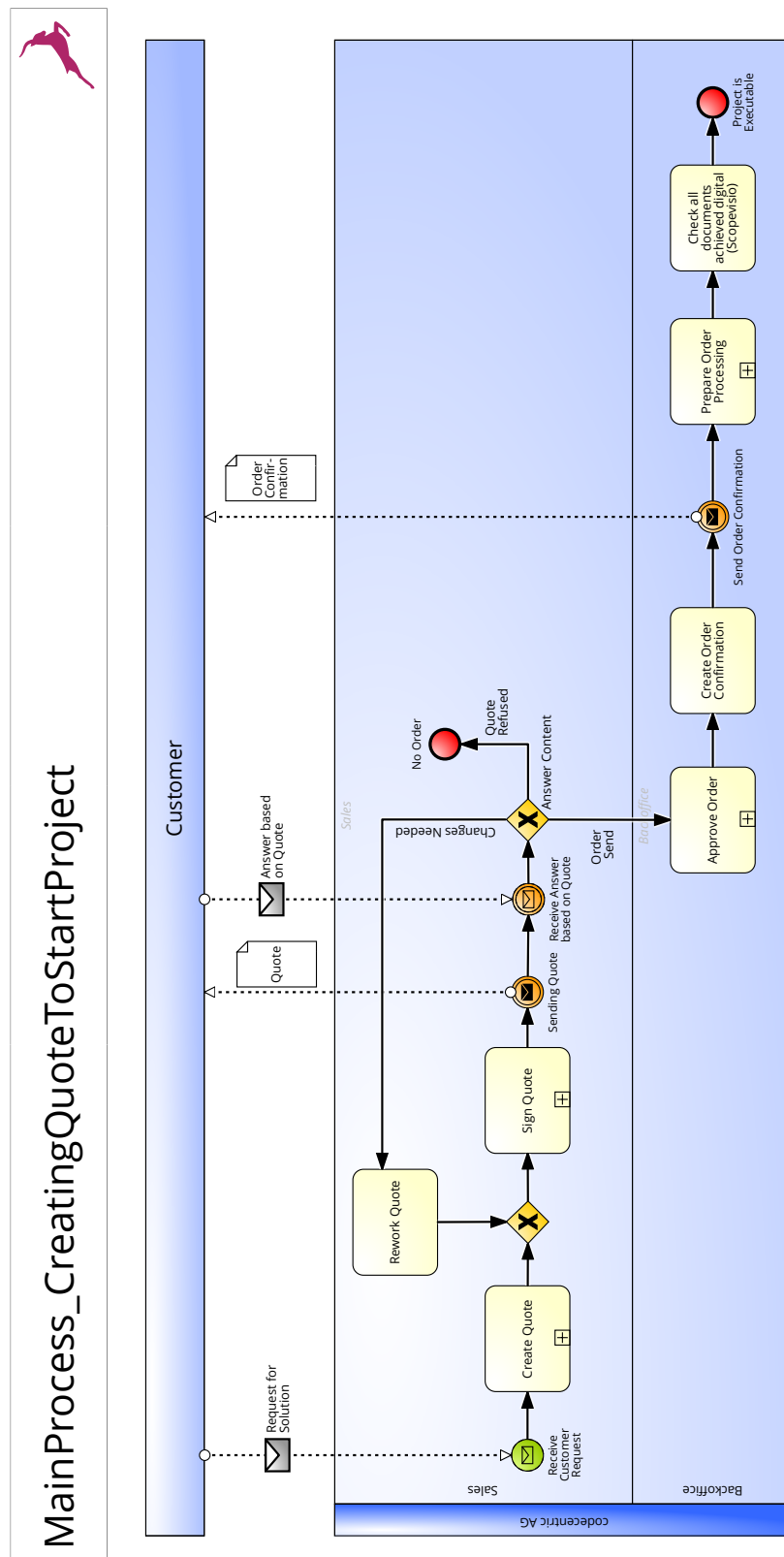
Figure A.1: Main Old Process

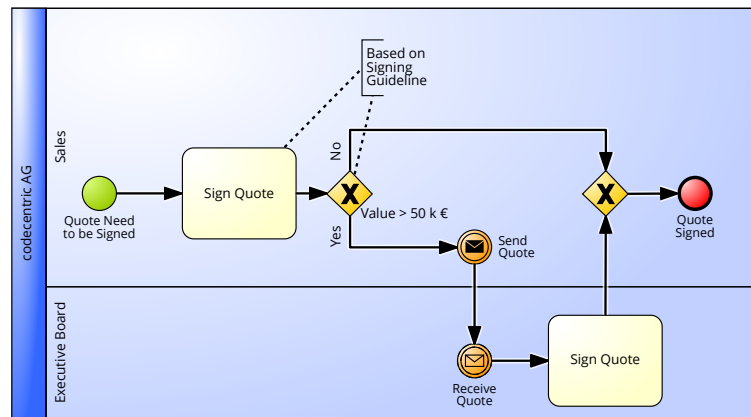# Process1_CreateQuote
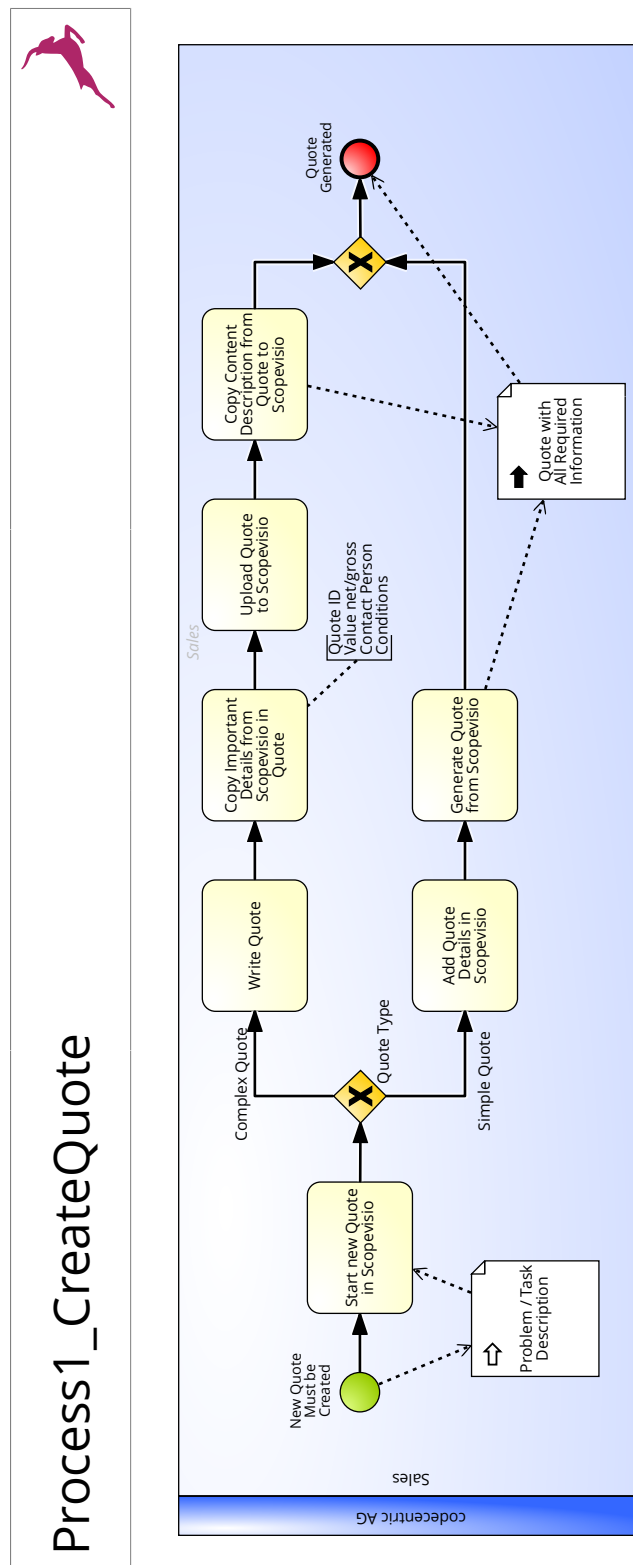
Figure A.2: First Old Subprocess - Creation of a Quote

Figure A.3: Second Old Subprocess - Signing of a Quote
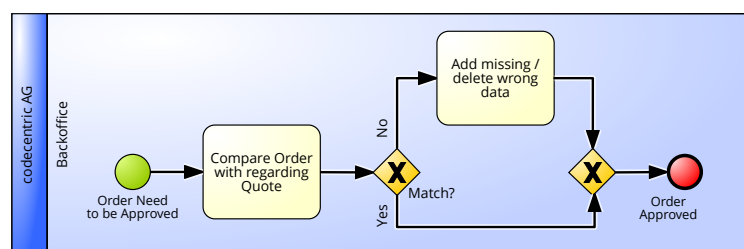

Figure A.4: Third Old Subprocess - Approve Order
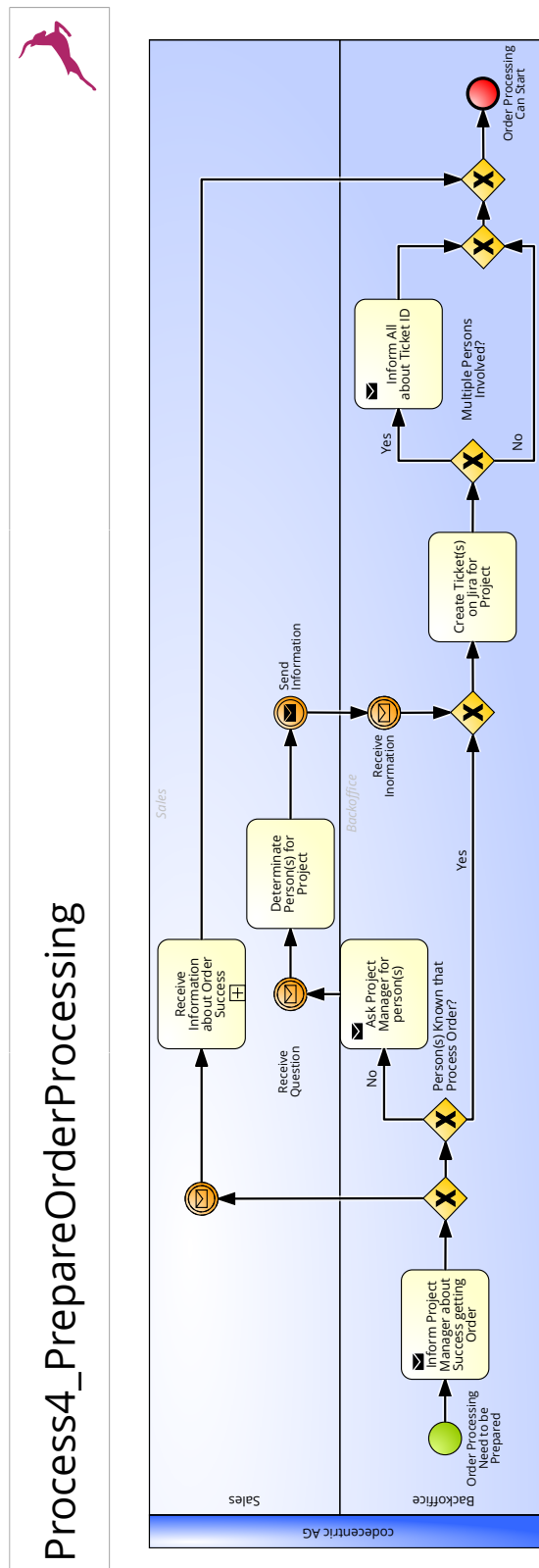
Figure A.5: Fourth Old Subprocess - Prepare Order Processing
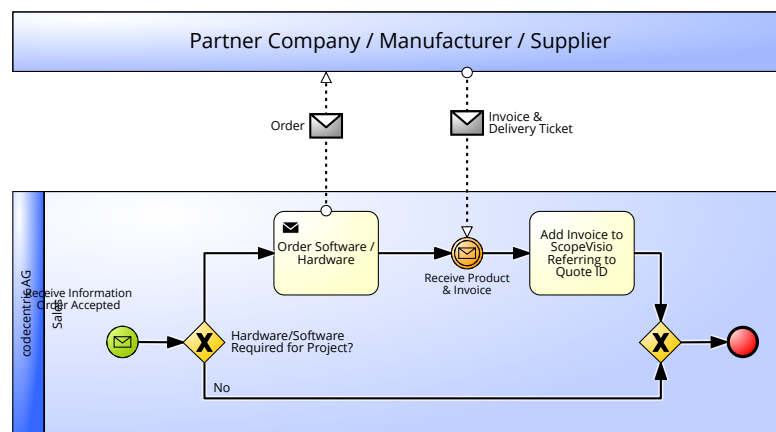
Figure A.6: First Old Subsubprocess - Order Needed Hardware and Software

Appendix B

Research about electronic Signature

B.1   Introduction

At codecentric AG a paperless office should be introduced. That means all contracts and offers possible should be signed and achieved in digitally way. Currently for some contracts a tool is used to sign documents digital, but that should be extended. Also, the achieving is done digital, but in a manual way with scanning of the signed documents and then uploading them to the achieve. Inside this research the topic of ES is covered, which is part of the paperless office.

This research contains the following aspects of a research: First the scope of the research is described, then the questions which will be answered in this research and how they are answered will be explained. Next the criteria and the weight of them are described to can advice which signature should be used later, followed by presenting the results of the research and a comparison of the different kinds of signatures. Finally, an advice is given.

B.2   Scope

The scope of the research is to get knowledge about ES and give an advice if the ES should be used and in the case of this option which type of ES. Aspects that should be covered are the way of working with ESs, the different types and the current legal status of ESs.

B.3   Questions

Regarding the research the following questions are mentioned:

- What is an ES?

- Exist different kinds of signatures?

- In the case of a yes, which are thay?

- How are they created?

- What is the process of using them?

- Which legal aspects exist by the usage of them?

- Are there regulations by law to use them by signing contracts?

The questions will be answered with an Internet research, reading German and European laws. As input for the research questions will be used for example "Biometrische elektronische Unterschrift Gesetzeslage", "electronic signature" or "laws electronic signature".

B.4   Criteria & Weightings

Inside this section the different criteria are explained and divided in their weighted categories. The criteria are the following:

- Verifiability:
  Importance: 3
  The signed documents must be legally valid as evidence. In the best case they should have the same legal rights as a document signed with a handwritten signature.

- Usability:
  Importance: 2
  The signing of the documents should be as easy and fast as possible. That means that it should be allowed for cloud services or applications accessible from all possible electronic devices.

- Extra hardware required:
  Importance: 1
  For some technologies extra hardware is required like a card reader or a component to sign with a pen. That leads to a lot of costs during the fact unknown how many employees need to have such hardware.

The table B.1 displays the different categories for each criterion and shows their weighting. The best weighting is (+ +) and the worst is (- -).

Criterion	Category	Weighting
Verifiability	No	- -
	Yes	o
	With tracking of documents changes	+
	Equal to handwritten signature	+ +
Usability	Only PC	- -
	Only devices with touch recognition	-
	All devices	+ +
Extra hardware required	Yes	- -
	Possible	o
	No	+ +

Table B.1: Categories and their weighting

B.5   Result

In some used sources there is no difference between the term "DS" and "ES". In this document there will be a difference. The "DS" is the signature of a digital document and the "ES" is the signing of a document through

a human or a machine to verify. This definition is also in the glossary.

An important aspect of ES is, that by default a document is never encrypted. This needs to be done separately. It is mentioned at this point, because it is fact for every implementation, regulation and law.

Since 2014 a regulation eIDAS for all EU member states and stats in the European Economic Area (EEA) (Bundesministerum des Inneren, 2018) exists, which is since the 1st July 2016 standard for all participants (Steffens, 2018a). A detailed overview what is inside this regulation and the realization of Germany will be explained in the following sections.

B.5.1 Legal Aspects

Currently exist several laws and regulations. Below the most important for Germany and the EU will be explained, because in these countries are most clients from codecentric AG placed.

eIDAS

As mentioned above is the eIDAS legal for all EU members and states in the EEA. That leads to the fact that all previous existing regulations from each individual country are superseded if they regulate aspects or topics of so called eIDs (electronic identification with various methods like electronic signatures or passports) and digital transactions (Steffens, 2018a; SignEasy, 2018). One of the aims is "... to enhance trust in electronic transactions in the internal market by providing a common foundation for secure electronic interaction between citizens, businesses and public authorities, thereby increasing the effectiveness of public and private online services, electronic business and electronic commerce in the Union"(European Union, 2014, p. 73 §2).

Inside these regulations the three different types of electronic signature are described:

1. Simple electronic signature (SES), also just called ES

2. AES

3. Qualified electronic signature (QES)

Additional the EU states three legal facts:

1. An ES is allowed as proof and should not be rejected only by the fact "that it is an electronic form or that it does not meet the requirements for qualified electronic signatures" (European Union, 2014, Article 25 § 1).

2. The QES is equivalent to the handwritten signature (European Union, 2014, Article 25 § 2).

3. The QES with a qualified certificate, certified by an EU member state, is also in the other EU states to be accepted as a QES (European Union, 2014, Article 25 § 3).

Furthermore, other regulation are defined like standards for certificates and the creation of the devices that generates QES.

Germany

Since the 28th June 2017 are the previous regulations for ESs (Signaturgesetz und Verordnung zum Signaturgesetz) are invalid. Instead the regulation "Gesetz zur Durchführung der Verordnung (EU) Nr. 910/2014

des Europäischen Parlaments und des Rates vom 23. Juli 2014 über elektronische Identifizierung und Vertrauensdienste für elektronische Transaktionen im Binnenmarkt und zur Aufhebung der Richtlinie 1999/93/EG (eIDAS-Durchführungsgesetz)" (Bundestag, 2017) is the new law. This regulation fulfills all the requirements needed that the eIDAS could be executed without problems and defines aspects in more detail (Bundesanzeiger Verlag GmbH, 2017). Additional changes were made in the Bürgerliches Gesetzbuch(Civil Law Code from Germany) (BGB). Important for ESs are BGB §125 et sequentes. Also, regulations for specific exceptions to the usage of ESs are defined in several other laws.

To use the ES to sign contracts all participated parties of that process need to agree on the usage. Therefore, a provision needs to be added informing the persons that if they continue the signing process they agree to the usage of ES. The complete process should be documented to show that everything was correct (Herfrid, 2017).

B.5.2 Types of Electronic Signature

Inside the eIDAS three types of ESs are defined, as explained before. Inside the following they will be described with more details and how they are working. Additional biometric data will be introduced as a topic.

Simple Electronic Signature

This type of signature is the one with the lowest provability, but since eIDAS it is allowed to be used within the court. The definition of an SES is to add electronic data to existing electronic data (European Union, 2014, Article 3). This leads to the fact that just adding a photo to a document with a handwritten signature satisfies the definition of the typed name below a document or mail (European Union, 2018).

But that could be easily manipulated or copied. Therefore, this type should not be used within documents that needs the identification of the signer.

Advanced Electronic Signature

The AES has a different requirement than the SES. It needs to be unique per signer in the sense that the person could be identified with the signature. Additional the AES is generated by a unique algorithm or out of data and the creator has this in his exclusive control. Furthermore, it needs the signature connected to the signed document in a way that changes of the signed document could be detected afterwards. (European Union, 2014, Article 26)

The most used technology for that is the public-key infrastructure (PKI) (European Union, 2018). This technology exist out of two keys that are connected with each other, so called public and private key. The private key needs to be always by the owner and should not get public, because then it is interrupted and the owner is not stable identifiable anymore. The public key is known by all parties documents and needs to be exchanged. Also, the algorithm used for an encryption must be published to all persons requiring it. The process is then the following:

1. The signer calculates the DS of the document to be signed.

2. The DS is encrypted through the private key of the signer.

3. The signer sends the document and the encrypted DS to the contract partner.

4. The contract partner receives data.

5. The contract partner decrypts the encrypted DS.

6. The contract partner calculates on its own the DS of the signed document.

7. The contract partner compares the calculated DS with the decrypted DS. Depending on the results two situations could occur:

   (a) Both DSs are equal:
       The signer is verified, because the decryption was correctly and the content of the document is not changed, cause the value is equal.

   (b) The DSs are unequal:
       With this document is something wrong. Either the wrong signer signed the document, the content was changed or both previous cases together.

The used public key and the encryption/decryption algorithm could be documented in a certificate that identifies the signer and is sent once or every time with a document.

Qualified Electronic Signature

A QES is a AES with more restrictions. The first restriction is that the signature needs to be " created by a qualified electronic signature creation device" (European Union, 2014, Article 3). This device could be physical like a smartcard or USB stick or remote in a cloud application (European Union, 2018). The second restriction is that a qualified certificate for an ES is required. This is a certificate that is allocated by a so called Trust Center, an institution that is regular controlled by a governance instance if they satisfy all the requirements defined in the eIDAS (European Union, 2018). With the certificate a validation should be given if a person exist similar to the passport in the non-digital world.

As mentioned as before the QES has equal rights than a handwritten signature. The problem is that the certificates and algorithms used for encrypting/decrypting the DS have a certain validity. After a settled time point, they are not trusted anymore. For algorithms that is five years and for certificates depending on the Trust Center mostly between two and three years, sometimes ten years. To keep the documents secure signed for a proof they need to be resigned after one of the signer gets a new algorithm or certificate (Steffens, 2018b).

Biometric Signature

There are different types of biometric data individual for each person, e.g. iris, fingerprint or the face. But also the signature is individual per person. And this type is already divided in subtypes. They are explained below:

- Static: the correlation between two images of a signature.

- Dynamic: the correlation of two signature data with X and Y position of the movements, the writing rhythm, pressure and acceleration.

(Biometric Institute, 2017; Thakker, 2018)

To get a good verification base the signer had to give the software multiple examples of his biometric signature (BS) by the registration. In the later usage the tool can decide based on the data received from the beginning

if the signature is correct (Thakker, 2018). Another methodology is to combine the previous method with the of the AES. Therefore, the signature will be encrypted and added to the file, a DS is calculated and also added to the file. At the end the receiver of the document can calculate if the signer signed the document and that the content did not changed.

The advantage of a BS is that the copying is not possible, because every person writes in his own style (all the details belonging to the dynamic subtype) and this style could not be copied even from specialist (Schmitz, 2004). But at the moment this signature is not equated with the handwritten signature as the QES and hardware is required that can recognize the signature such as tablets.

B.6   Comparison

This section will compare the the result of the research. Therefore a summary is done and afterwards the comparison. Based on the criteria defined in section B.4 the different types of ES are summarized with the regarding weight. That is done in Table B.2.

Criterion	Signature Type			
	SES	AES	QES	BS
Verifiability	o	+	+ +	o
Usability	++	++	+ +	-
Extra hardware required	+ +	+ +	o	o

Table B.2: Summary of electronic signature types based on criteria

To make a better comparison of the different ES types, a translation from weighting to points is done in table B.3 which is used in a later calculation.

Weight	- -	-	o	+	+ +
Points	-2	-1	0	1	2

Table B.3: Translation of weights in points

To get a complete image of the result the translated weights are multiplied with the importance of the criterion. To make it visible:

*Sum = Importance Criterion * Points of Weight*

The result of that calculation is presented in table B.4.

Criterion	Signature Type			
	SES	AES	QES	BS
Verifiability	0	3	6	0
Usability	4	4	4	-2
Extra hardware required	2	0	0	0
Total sum	6	7	10	-2

Table B.4: Comparison of electronic signature types

B.7 Advice

In general need to be said that ESs are a good alternative for handwriting signatures, especially in EU states. The focus is on the type of ES. The result from the comparison in section B.6 is that the QES fits the requirements explained in section B.1 best. Also, from the legal aspect would it be the best solution, cause of the fact that it is equated to the written signature in the most cases. Even customers with a high demand on legal aspects will be satisfied with that signature, cause of the possibility to track document changes after the signing and the identification of the signers. But in the case the handwritten signature is not mandatory by law, the AES is also a good solution. It is mostly also the one with lower costs and has the same functionalities as the QES with identifying the person and tracking the content changes.