

# **Introduction of a Contract Management Workflow at codecentric AG**

Bachelor Thesis - Final Report

Submitted by Pia Erbrath

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## Abstract

Within the company codecentric AG the old process for document handling should be replaced through a new one with a contract management system. Together with the restructuring the electronic signature should be introduced in the company. This development is done, because there are currently a lot of problems like too much manual work within the signing process and document processing or non-fulfillment of the old signing guideline.

With the new process, targets like satisfying of the new signing guideline by all employees of the company and reducing manual work and paper usage in the office should be reached. The development of a complete contract management system will not fit the time frame of the project, therefore the focus was on introducing the electronic signature at the company. To satisfy legal aspects a research was made about electronic signature, which is legally accepted for over twenty years. After clarifying the legal situation a research was made for systems that can be used for the new process.

Due to external circumstances it was not possible to develop a complete system that combines the current document storage with the signing system. Therefore, a prototype development is made to test the new process. In the future, the prototype will be presented to other potential customers.

## Zusammenfassung

Bei der Firma codecentric AG soll die Dokumentenverwaltung ersetzt werden durch einen neuen Prozess in Verbindung mit der Nutzung eines Vertragverwaltungs System. Zusammen mit der Umstrukturierung soll die elektronische Unterschrift im Unternehmen eingeführt werden. Diese Entwicklung wird gemacht, damit aktuell existierende Probleme wie zu viel manuelle Arbeit oder die häufige Nichteinhaltung der Unterschriftenrichtlinie behoben werden können.

Mit dem neuen Prozess sollen unter anderem folgende Ziele erreicht werden: Einhaltung der neuen Unterschriftenrichtlinie von allen Angestellten und eine Reduzierung sowohl der manuellen Arbeit, die ausgeführt werden muss für die Dokumentenverwaltung, als auch die Papiernutzung durch Digitalisierung. Aufgrund der Tatsache, dass ein komplettes Vertragverwaltungs System in der vorgegebenen Zeit nicht erstellt werden kann, ist der Fokus auf das elektronische Signieren von Dokumenten gelegt. Dafür werden zwei Recherchen gemacht: eine über die aktuelle legale Lage der elektronischen Unterschrift, welche schon seit über zwanzig Jahre rechtlich anerkannt ist, und über Systeme, die schon online die elektronische Unterschrift anbieten.

Aufgrund von äußeren Umständen war es nicht möglich ein System zu entwickeln, dass die aktuelle Dokumentenspeicherung des Unternehmens mit dem Signier System. Stattdessen wird ein Prototyp entwickelt um den neuen Prozess und dessen Effizienz zu testen und es in der Zukunft potentiellen Kunden vorzustellen.

## Statement of Authenticity

Issued by the FHTenL Examination Board, September 2017

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# Glossary

Notation	Description
digital signature	The digital fingerprint of a digital document, also called Hash value
GDPR	General Data Protection Regulation Regulation from the European Union regarding data processing, storage and handling. Valid since 25th of May 2018.
SDK	Software Development Kit Collection of tools, documentation and libraries for software development
smartcard	A card with a chip on it, that stores data e.g. biometric data or certificates. It compares access data like a personal identification number with input data. Only if the data match each other, the user is identified and the rest of the data stored is accessible

# Acronyms

<b>Notation</b>	<b>Description</b>
AES	Advanced Electronic Signature
API	Application Programming Interface
App	Application
BGB	Bürgerliches Gesetzbuch (Civil Law Code from Germany)
BPMN	Business Process Modeling and Notation
BS	Biometric Signature
cc	codecentric AG
CD	CenterDevice
CMS	Contract Management System
DB	Database
EEA	European Economic Area
eIDAS	electronic IDentification, Authentication and trust Services
ERP	Enterprise Resource Planning System
ES	Electronic Signature
EU	European Union
GTCT	General Terms and Conditions of Trade
HR	Human Resources
IT	Information Technology
LDAP	Lightweight Directory Access Protocol
MB	Mega Byte
MVC	Model View Controller Pattern
NDA	Non-Disclosure Agreement
OP	On-Premise

<b>Notation</b>	<b>Description</b>
OS	Operating System
PDF	Portable Document Format
PKI	Public-Key Infrastructure
QES	Qualified Electronic Signature
REST	Representational State Transfer
SaaS	Software as a Service
SDK	Software Development Kit
SES	Simple Electronic Signature
SMS	Short Message Service
SQL	Structured Query Language
UML	Unified Modeling Language
USA	United States of America
XML	Extended Markup Language

# Chapter 1

## Introduction

This document is the report about the bachelor thesis of Pia Erbrath. The author is a student from the Fontys Hogeschool Techniek en Logistiek at the site in Venlo, Netherlands. The following chapter provides an overview about the context, the company where the bachelor thesis is elaborated and the document structure. It is expected that the reader has a basic understanding of software design and development to properly comprehend the chapters design and implementation later in this document.

### 1.1 Context

At the end of the study, which has a duration of eight semesters, a bachelor thesis needs to be created. The bachelor thesis is to be done in a company, to get practical work experiences and to apply the knowledge that was 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)
- Consultancy service for software and performance
- Software development
- Training and workshops for developed software

At the moment cc has fifteen locations in Europe and about 500 employees. Cc has also two subsidiary start-ups, CenterDevice (CD) 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 technologies like *Internet of Things*, *Big Data*, *Continuous Delivery* and more. A lot of customers from several areas and sizes use these competences and products.

The headquarter of cc is located in Solingen with space for 200 employees. Several departments are located here like Finance, Sales, Document Solution and the team of CD. The bachelor thesis is executed in the department Document Solution, which has currently a size of 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. After the introduction, the project assignment is described in chapter 2 followed by the project management in chapter 3 and an analysis of the initial situation is given in chapter 4. Then the requirements for the new process are defined in chapter 5. In chapter 6 a short overview about the researches of the project is given, followed by chapter 7 about the design of the created application. Afterwards the implementation is described in chapter 8 and thereafter recommendations are given for further implementations in chapter 9. Finally, a conclusion is given within chapter 10.

## Chapter 2

# Assignment

This chapter gives an overview about the bachelor thesis project. Therefore, the problem of the initial situation and the assignment of the project 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 develops among others the software and hardware for mobile devices and Windows operating systems that can be used for graphic design or to sign documents (Wacom, 2018c). But currently they develop a new SDK for their Application (App) *sign pro PDF*, which allows the signing of documents on a mobile phone with their pen hardware technology (Wacom, 2018b). 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 realizable to develop the CMS.

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 their requirements anymore. One big aspect for them is to reduce the paper work and automate or simplify several processes regarding making quotations, orders and invoices, starting projects and storing data at one spot 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 sporadic, but there are a lot of situations left where it could also be used as well. This means that all possible contracts, quotations and Non-Disclosure Agreements (NDAs) should be signed with the ES and stored digitally, so that the paperless office can be created. Included in the task is the creation of a workflow, that automates the process of subscribing according the signing guideline of cc so that administration costs could be reduced and the response time is decreased. Due to the fact that cc will introduce a new ERP this year, it will only be a proof-of-concept, with a mocked ERP.

In the case that there is time left, the creation of contracts and quotations based on templates and existing customer information should be added to the workflow. The archiving of contracts according to governmental and cc-internal regulations should be automated. In general already existing tools should be used for the

realization of the project.

## 2.3 Scope

The focus is the creation of a process for the electronic signing of documents. Therefore, a system needs to be created that connects an ERP with a tool that coordinates the document signing. Additionally, the writing of the bachelor thesis is part of this focus. Only in the case that time is left until the end of the project, additional functionality should be implemented like archiving the signed documents and the template creation of contracts and quotations. The thesis concentrates 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 are all other document types than quotations, contracts and NDAs. They will be focused after the internship, also due to the fact that more legal questions need to be clarified.

## 2.4 Phases & Products

There are five phases in the project:

1. Project planning
2. Analysis of the initial situation and the requirements
3. Research about used tools
4. Implementation and testing of the system 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 initial situation
- Research about ES and tools that could be used to sign documents electronically
- A system as proof-of-concept with a documentation
- The bachelor thesis (this document)

## 2.5 Motivation

There are different motivation aspects behind the project. First of all is the reduction of work. When the steps of creating, signing and archiving of documents are automated, the employees could work more efficient. The response time gets faster regarding 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. Its workflow is the following: Only if the current phase is finished, the next phase can be started. In the phases itself another working model can be used. For this project it is only done in the implementation and testing phase. There a customized version of the agile approach *Scrum* is used.

The customized *Scrum* works in the following way: At the beginning of the implementation so called *User Stories* were defined, that are requirements described in a has-to-scenario like “The user wants to login to the system”. They are defined by the customer and the *Product Owner*, a role within the methodology that is responsible for the final product and the customer communication. This role is played by the site manager Christian Böhm. All *User Stories* are collected in the *Product Backlog*, which is within the project an *Excel* sheet. It is added in the appendix F. During the implementation more *User Stories* could be created, that are easily added to the *Product Backlog*.

The implementation is done in time frames called *Sprint*. In the normal case they have a time limit, but inside the project the decision was made to end a *Sprint* when all work of it is done. For each new *Sprint* a *Sprint Planning* is done, in which all involved roles *Product Owner*, Developer and *Scrum Master*, which has the responsibility to coordinate and manage the team but is inside this project not used, plan the next iteration of work. Within this meeting certain *User Stories* are collected from the *Product Backlog* to be processed within the next *Sprint*. These *User Stories* are collected in the *Sprint Backlog*, which stores all *User Stories* of this *Sprint*. Within the project they are placed in the same document as the *Product Backlog*. For each *User Story* the time is calculated in which it should be finished. In the case a *User Story* gets the status “Done” some criteria need to be fulfilled, that are defined in the *Definition of Done*. The *Definition of Done* for this project is placed in the appendix E.

Within a *Sprint* the typical *Daily Scrum* meeting is ignored, due to the fact the developer team has a size of one member. When the *Sprint* is finished, a *Sprint Review* meeting is held to proof the acceptance of the implemented *User Stories* by the *Product Owner* and customer. Afterwards, the next *Sprint* is planned. (Scrum.org, 2018)

The usage of *Scrum* helps to develop a product that fulfills all requirements specified by the customer and

which is maintainable for further improvements. This happens as a result of the continuous implementation of additional functionalities in existing basic functionalities. Furthermore, an always working product is delivered at the end of each *Sprint*.

## 3.2 Time Planning

The project implementation will be done in an agile way, that means for the implementation of the workflow 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.

Phase	Week	Activity	Calendar Week
1	1-4 4	Project planning, Topic introduction Research ES	5-9 9
Milestone I	06/03/2018	Project Plan	10
2	5,6	Analysis current state & requirements	10-11
3	7	Research tools	12
Milestone II	27/03/2018	Midterm report	13
3	9	Research tools	13
Milestone III	05/04/2018	Midterm presentation	14
4	10,11	Designing new workflow	14-15
4	12-17 18	Implementing system Testing system	17-21 22
5	19	Final preparation of report & presentation	23
Milestone IV	26/06/2018	Final Report	26
Milestone V	04/07/2018	Final presentation	27

Table 3.1: Time planning of project

## 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 documents of high quality two techniques are used. On the one hand the writing is done with a tool that checks the orthography and the grammar and on the other hand is the document reviewed by other persons to check the logic and understandability.

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 have to be fulfilled. Therefore, tools will be used that can handle the checking. Additionally 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. Moreover a definition of done will be created (see appendix E), that ensures the quality of the developed code.

The created results will be regularly presented and discussed with involved persons. This allows to possibly avoid bigger problems, due to early detection during the presentations and discussions. The quality management is agreed with the company.

### 3.4 Deliverables

At the end of the internship the following things need to be delivered:

- **Project Plan:** Inside this document the first planning of the bachelor project is written down. The reason of the existence of this document, is to get an overview of the bachelor thesis project for all involved parties. The parties are listed at the information page.
- **Visualization of the current process:** To get an overview about the current process of the sales department a visualization of their process is done with Business Process Modeling and Notation (BPMN) diagrams. Based on them an analysis is done (see chapter 4). The diagrams are placed in the appendix A.
- **Research documents:** During the bachelor thesis two researches need to be done. The first one is about ES, which is placed in the appendix B. It was done to get knowledge about ES and to clarify which ES could be used at cc. The other research is about tools, which already implement the ES of documents and can be used for the system to be created during the bachelor thesis. The research document is in the appendix C.
- **Design visualization of the system:** To get an understanding of the created system, its design should be visualized by several diagrams with Unified Modeling Language (UML) standards, like a class diagram or activity diagrams. The diagrams should present the structure of the implementation and the processes of the systems.
- **Documentation of the system:** Another deliverable is the documentation of the system. This includes user manual, administrator guide and developer documentation (source code, architecture description, etc.). They should give help to work with the later system in the case the author is not available anymore after finishing the project.
- **Report of thesis:** To give an overview about all things done and decisions taken during the bachelor thesis project a document is to be created, which will be read through the examiners of the bachelor thesis.

### 3.5 Risk Management

Inside this section risks will be presented in the table 3.2.

#	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	Occurred and Closed
3	New technology / programming language / Application Programming Interface (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	Occurred
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	Occurred
5	ERP	Currently the Backoffice/Finance/Human Resources (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 workflow could not be implemented at the end of the project.	Late decision, no possible to fit workflow to the ERP	Communication, get information about the current state	5	5	Occurred and Closed

Table 3.2: Risk Register

## Chapter 4

# Analysis of the Initial Situation

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

There is no existing CMS at the moment. Cc has a process established that fulfills partly the signing guideline of the company. In the appendix A the business process from the initial state is visualized. The process will be described the section 4.2.

### 4.1 Signing Guideline

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

Position	Amendment	Document Types
Chairman	-	All document types can be signed.
Procurator	ppa	All employees belonging to this group have the right to sign all documents with the same rights as the chairman.
Site & HR manager	i.V.	The group has a general authority to sign documents, but there are more 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 quotation with an amount 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 employ-ees	i.A.	This group is allowed to create quotations and sign them if this belongs to their tasks and the amount of the quotation 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 price of a contract or quotation. This needs to be known by the person who wants to sign a document. Additional information about the positions of employees is required.



## 4.2 Business Process

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

### 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:

- **Quotation:**  
Is a document in which cc gives the customer an overview about the approximated work, necessary software, 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 Quotation:**  
An uncomplicated quotation, which has only a few listings of needed Software and Hardware and estimated working time and their prices. It is always based on the General Terms and Conditions of Trade (GTCT).
  2. **Complex Quotation:**  
A quotation for a bigger project or company. Inside this document a lot of explanations about tasks and topics are placed. Also, the amount is mostly higher than 50.000 € and can have regulations regarding the paying of the amount. Furthermore, this type may have different legal foundation than a simple quotation. Moreover, it could be that inside this project external employees are involved and the quotation explains the conditions of this situation. In general with this quotation type more interactions with the customer is required.
- **Order:**  
A document sent from the customer to cc, that has as content the information which quotation is accepted. Furthermore, it needs 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 by a team of cc.

## Involved User Groups

Currently the following parties are involved in the business process:

#	Role	Description
1	Customer	This user group wants 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	This user group creates the quotations and will process the orders if the quotations are accepted by the customer.
3	Backoffice	This actor group coordinates the incoming orders and keeps track of the completeness for all documents needed for the order.
4	Executive Board	Consists out of chairmans and procurators of cc. This group is only involved inside the process if the amount of a quotation 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

## General Process

The general process is visualized in figure 4.1. 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 quotations and the backoffice for coordinating and setting up the requirements to start working on the orders coming in based on the quotations.

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 quotations are generated out of it and all documents are stored based on a defined structure. With *Microsoft Word* and *Google Docs* mostly the more complex quotations 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 quotation visualized in figure A.1. This process is placed in the sales department. They use the ERP tool *Scopevisio* to generate the metadata of the quotation and depending on the category of the possible project either a simple quotation is generated or a complex quotation.

In the figure A.2 the second subprocess is shown. It visualizes the signing process of a quotation. The document needs to be signed regarding the signing guideline of cc. An overview is given in section 4.1. At a certain price level the executive board needs to sign the contract additionally. At the moment the signing can be done in two ways. First manually on paper and afterwards send the contract in duplicate to the customer with a letter. Or scanned the signed contract and then send it by email to the customer. Sometimes it happens that the signing is ignored by the employees.

The next subprocess is the approval of the order of the customer, presented in figure A.3. The backoffice checks if the order is conform to the stored quotation in *Scopevisio*. In the case there are some inconsistencies they will be removed. Finally, the order is approved.

The last subprocess is the setup of the order processing. This process is presented through the figure A.4. First the backoffice informs the project manager that they successfully agreed with the customer. At this point the next subprocess is started. This is shown in figure A.5. In the case that additional licenses or hardware components are required, they will be ordered and the invoices and delivery tickets will be added to *Scopevisio*. Then it goes back to the previous process.

The backoffice identifies the persons, that should process the order, and is creating for them a task ticket on *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 most documents are signed manually. This leads to several other problems:

- The signing process can take a lot of time:  
Due to the fact that some document types need to be signed from one of the governing board, leads this to a further problem: There are fourteen sites without a person having this status, the document needs 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 email 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.

Additionally it could happen that no person, that has to sign the document, is available in the headquarter and it may take some time until he can sign the document.

- Not all documents will be signed correctly according to the signing guideline:  
Sometimes the situation occurs that documents are not signed according to the signing guideline, for example a missing amendment, or a person without the needed authority signed the document. This is because of the complex process and not controlled actions. Monitoring all documents is not feasible due to technical limitations.
- Not all documents will be signed:  
In many cases documents are not signed because employees think, it is too much effort or the employees do not know that they need to sign the documents.

In some cases the online tool *DocuSign* is already 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 person, that needs to sign the document, has to be specified before sending it. In the case an additional person from cc needs to sign the document, based on the signing guideline, they also have to be specified. If the selected person does not recognize the request of signing, it also can take time to get the signature.

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

Another problem is the creation of documents. In the quotation generation process often formal mistakes are inserted like an incorrect period of payment, especially if the customer has a different arrangement with cc as the GTCT. Additionally 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 practical anymore in some parts for cc.

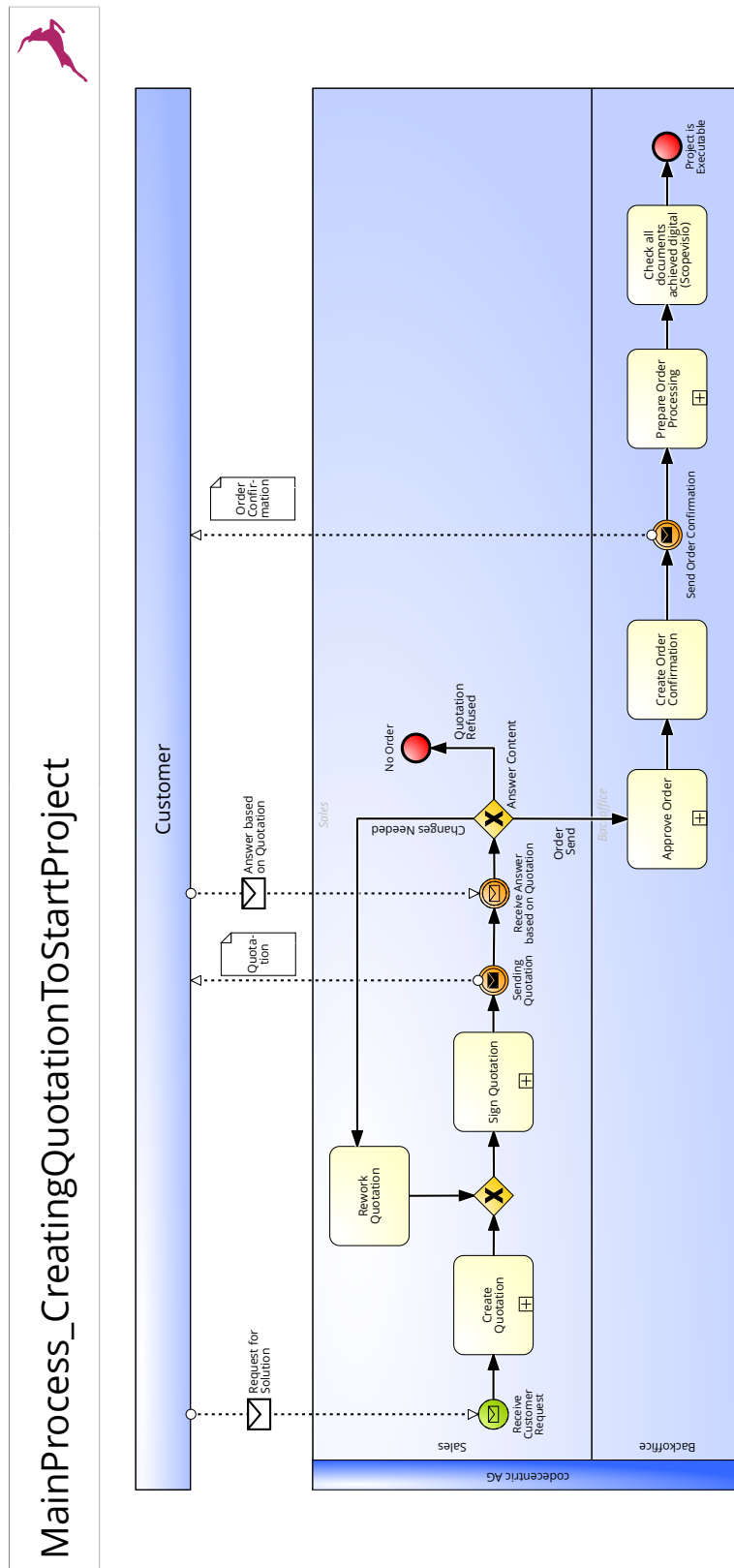


Figure 4.1: Main Old Process

## Chapter 5

# Requirements for the New Process

The new business process should solve the problems explained in section 4.3. But additionally there are more requirements to the new process in the technical and formal area. An overview about the general goals and their requirements are given in table 5.1. They are explained afterwards in this chapter. First the goals of the new process are explained. Next the requirements are described and finally a description of the new process and the new signing guideline is presented.

Goal	Requirement	Importance
Satisfy signing guideline	Checking of fulfillment	High
	Transparency	High
Reduce manual work	Automate document creation	Low
	Automate signing process	High
	Automate document archiving	Medium
Reduce paper usage	Accepted file types	High
	Fulfillment of legal standards	High
	Sign most documents electronically	Low
Introduction of a corporate-identity	One document design	Low
	Sending about defined mail addresses	Medium

Table 5.1: Overview goals and requirements

### 5.1 Goals

The company cc hopes that the new process can solve the problems they currently face. Therefore, they defined the following goals that should be reached with the new process:

1. Satisfy signing guideline.

In the future all documents should be signed according to the signing guideline. It should not be possible to send an unsigned or incorrectly signed document to the customer. Furthermore, the employees should not think about what they need to sign with which amendment. The system should predetermine the needed fields that have to be filled in.

2. Reduce manual work.

The interaction with the sites of cc should get faster and simpler. Also, the creation of documents should be done based on templates to reduce the formal mistakes inside of the documents and give the

employees standards for them. Moreover, the manual work should be reduced. In the best case the system automatically fills the default information in and add the fields for signing without any help of an employee.

3. Reduce usage of paper in the office.

Due to the fact that all contracts and belonging documents are either stored electronically or need to be archived in the headquarter at Solingen. This leads to a situation that the documents, when they are archived electronically, will be disposed properly or send by letter to Solingen and placed there in the physical archive. In the case that this will be done mostly electronically, the costs will be reduced for the proper disposal, sending, maintenance and place of the physical archive.

4. Introduction of a corporate-identity:

At the moment no corporate-identity exists within the different documents, due to the fact that they are created inside different tools and by several templates. In the future they should have the same style (color, font, size, etc.) and basic layout.

The result should be that cc can work more effectively, so that the reaction time by customer requests can be speed up and unnecessary, error-prone work can be reduced, due to automation by fulfilling given regulations from the government and the executive board of cc.

## 5.2 Requirements

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

1. Automated control about fulfillment of the signing guideline:

The new process should make it simple to fulfill the signing guideline. In the best case, all involved parties should automatically be invited to sign in the correct order, based on the signing guideline. This functionality requires an automatic insertion of the needed data fields for example 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 does not need to know who had to sign.

2. Transparency of the signing guideline:

Through the new process the signing guideline should get more transparent for the staff of cc. This means that during the creation of a document the employee should get the information whether he needs 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.

3. Automated document creation:

To avoid errors by manual copying data from one place to another like ID of the quotation or the volume, it should be possible that there are templates for all document types (e.g. quotation, contract, invoice). In simple cases this could be filled in directly or partially by the system and completed by an employee. The templates need to be created with people that know the requirements of each document type.

4. Automation of the signing process:

Another point is the signing process. In the best case the required fields should be set automatically and the control about the procedure should be handled by the system automatically as well. The signer and the initiator of the system could care about other things than coordinating the signature, for example sending a mail to remind or select who had to sign the document. This avoids errors and creates free time for the initiator.

5. Automated archiving of documents:

All documents should be archived regarding their content and relation to other documents. This should lead to a clear structure, which is easy to understand and simple to use for the employees working with that document. In the end, the amount of work for searching and archiving should be reduced and the processing of other tasks should get faster due to the sorted archive.

6. Accepted file types:

Currently the following document formats are used to create and store documents at cc: Portable Document Format (PDF), *Microsoft Words* .docx and *Open Office Writers* .odt. They should also be used in the new process, to avoid problems with the usage and installation of the new software for document creation. Additionally it should not be too complicated to allow new documents formats.

7. Fulfillment of legal standards:

Another requirement is that the new process needs to fulfill legal standards. This includes aspects of data protection regulations regarding electronic signature and security aspects. Additionally it needs to care that the standards from the customer, partner and the company itself have to be satisfied.

As the ES service the Advanced Electronic Signature (AES) implementation should be used, because it makes it possible to ensure authenticity and integrity as it can be seen in appendix B. A short summary is given in the section 6.2.

8. Sign most documents electronically:

In the best case all documents possible should be signed electronically, but therefore a lot of legal requirements need to be considered. At the moment quotations, NDAs and contracts with the customer are most important. In this case most documents are signed with the new way, a lot of workload for the backoffice employees is reduced and the cost for storage and paper is decreased.

9. One document design:

To achieve a corporate-identity throughout the different document types, a general document design needs to be created with a layout, used font style and more aspects. Therefore, the help of designers is required. The design should be used for every document that is used for interactions with customers, potential employees and other situations.

10. Sending of documents via predefined mail addresses:

Furthermore, it will be helpful when the documents could be sent through one email address specified per responsibility like quotations 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 determines, that the authenticity and integrity of a received document via email needs to be guaranteed.

If those requirements are realized, the goals should be reached. Due to the fact that they all have different priorities as shown in table 5.1, they will be processed in a different order than they are listed above.

## 5.3 New Process

The new process should coordinate the signing of documents. Therefore, the user should be able to search for documents by name, type of the document, related customer or the name of the employee that placed the document in the document storage or ERP. Afterwards the user can select a document from the search result, and the system implementing the process checks if the user is allowed to sign the document. If needed, the system gives the user the choice to specify the person, who has to sign along with the user. When all required information is defined, for example email addresses and names of persons involved in the signing process, the



system sends them all together with the document to the tool for the ES. Finally, the user needs to check if everything is correct and the signing sub process can be started. This should be controlled by the other tool.

## 5.4 New Signing Guideline

Since the first April 2018 cc has a new signing guideline, which should solve the problems with the old one. In table 5.2 the documents that are focused in this project are represented. In the table a '-' represents, that the person in that position not allowed to sign the document.

Document		Company Position				
Type	Value	Employee	Salesman	Manager	Procurator	Chairman
Quotation	$\leq 50.000 \text{ €}$	alone	alone	alone	alone	alone
	$> 50.000 \leq 400.000 \text{ €}$	-	with Manager / Procurator / Chairman	alone	alone	alone
	$> 400.000 \text{ €}$	-	with Procurator / Chairman	with Procurator / Chairman	alone	alone
Contract	$\leq 50.000 \text{ €}$	-	alone	alone	alone	alone
	$> 50.000 \leq 400.000 \text{ €}$	-	with Manager / Procurator / Chairman	alone	alone	alone
	$> 400.000 \text{ €}$	-	with Procurator / Chairman	with Procurator / Chairman	alone	alone
NDA	/	-	-	alone	alone	alone

Table 5.2: New Signing Guideline Presentation

This signing guideline needs to be fulfilled by the new process. Moreover, there needs to be a storage for all persons regarding their position at the company.

## Chapter 6

# Researches

Inside this chapter an overview about the two researches, which are made during the project, is given. First of all the research about electronic signature is explained, where general information was collected for the project. The second research is about electronic signing tools, which was the main research for the project. And finally the changed requirements of the project are listed.

### 6.1 Research about Electronic Signature

Within the first weeks of the bachelor project the research about electronic signature was created. It is added in the appendix B. This section will give a short overview about the scope, criteria, how it was executed and the result of it.

#### 6.1.1 Approach

The aim of this research was to gain knowledge about ES in general. Cc uses an ES at the moment, but there was not a clear regulation about its usage. This should also be clarified in the research. Included were aspects like the legal situation in Germany and the EU. Moreover, the different types of ES should be analyzed and an advice should be given which one to use. Therefore, different questions were set up and criteria were defined together with the employees of cc. At the end an advice should be given whether ES should be used at cc and when the advice is positive, which ES type should be used.

#### 6.1.2 Strategy

To fulfill the approach an internet research was done. Governance documents, papers from companies that provide tools for electronic signature and lawyer blog posts have been found. The information are taken into account based on the date they were written (some of them were outdated by newer legal changes) and credibility of the author.

#### 6.1.3 Result

Since the year 2014 an EU wide regulation for ES exists, called electronic IDentification, Authentication and trust Services (eIDAS), which needs to be fulfilled by the 1st July 2016 in all EU member states and the

European Economic Area (EEA) (Bundesministerium des Inneren, 2018; Steffens, 2018a). Also, in most other countries in the world the ES is accepted by governance.

Moreover, exist four different ES types:

1. Simple electronic signature: The easiest ES, but also with the lowest provability. Can be the typing of the name at the end of a document or inserting an image with the signature (European Union, 2014; European Union, 2018).
2. Advanced electronic signature: More complex ES type, which guarantees that no changes are made to the document after it is signed and identified by the signer (European Union, 2014).
3. Qualified electronic signature: In general the same as AES, but with provability and certification by governance instances. Mostly requires additional hardware, but there are solutions on the market, which do that inside a cloud service (European Union, 2014; European Union, 2018).
4. Biometric signature: This type is at the moment not explained in detail and is not accepted by governances. There are two sub categories with different approaches: static and dynamic. Both are good to identify the signer, but depending on the implementation it is not possible to detect document changes. Furthermore, additional hardware is mostly required for the signing process.

After all it would be advisable for cc to use either the Qualified Electronic Signature (QES) or AES, because both identify the signer and detect document changes after signing. Their points have only one value difference, see table B.4 for further details. And regarding usability and costs factors, the AES fits for the standard use cases at cc and the legal standards.

## 6.2 Research about Electronic Signing Tool

To introduce a new process for signing documents electronically there are two options: Either the ES tool is created or an already existing tool is used for ES. In relation to the requirements for ES tools and their acceptance by the customers of cc, it was not an option to develop a new solution. The major reasons are the time constraints and the high expectations that need to be fulfilled. Therefore, the decision was made to use an existing tool. This results in a research for tools that could be used. The complete research is placed in the appendix C.

### 6.2.1 Approach

Within the research a tool should be selected that best fits the requirements of cc. They are influenced by financial and programmatic aspects. To figure them out questions were created and needs of cc are documented from the new process. Then a selection of tools was made and tested. Tools will be weighted and in the end a conclusion is made to decide on one tool.

### 6.2.2 Strategy

First of all, the criteria were defined together with members of cc. Based on that a selection of tools was made that are taken into account. Therefore, partners of cc were requested if they have a solution, suggestions from employees are collected and web comparison portals are used to identify potential candidates. Afterwards a scenario was created to test all of them on usability and ease of use. In this case additional information are

required they are either collected from the websites of the provider, related blogs or from interviews with the sales departments of them. In those interviews demos were given and an analysis of the required functionalities was made.

### 6.2.3 Result

This research has nine potential candidates for the tool: *Wacom* technology for electronic biometric signature, *DocuSign*, *HelloSign*, *SignDoc*, *AdobeSign*, *SignNow*, *eSign Live*, *PandaDoc* and *eSignAnyWhere*. Most of them have a similar functionality, only *Wacom* and *SignDoc* were not really testable, because of hardware problems and are not taken into account in the final comparison. Furthermore, *AdobeSign* is not in the final comparison, because of missing information despite repeated demand.

In the end *DocuSign*, *HelloSign* and *eSignAnyWhere* are the tools with the most points and are closely ranged. *HelloSign* has the most points, followed by *DocuSign* and then *eSignAnyWhere*. But it is advisable to use *DocuSign*, because there is a German-speaking support available, it has a higher security standard and all requested functionalities are available. However, it is a bit more expensive.

## 6.3 Change of Requirements

During the time the research about ES tools was created, it was revealed that the current ERP will be replaced through a new ERP till the end of the year 2018. Therefore, a complete set of requirements will be engineered and this has already started during the second phase of the project. Moreover, the fact was given, that the end of the project is the earliest date, where it will be clear which new ERP is introduced at cc. But due to the fact that using the API of the signing tool will cost money it was decided to not buy such a license. Moreover, there are no information available about the costs of the API of the current ERP *ScopeVisio*. Instead of creating a complete system, a prototype should be created with the developer API of the tool *DocuSign*, but the system should be created in an exchangeable way. The ERP should be simulated.

## Chapter 7

# System Design

Within this chapter the general design of the system that will be implementing the new process is described. First of all the general design is discussed, followed by an explanation about the used languages and frameworks. Finally, the rule set request is explained.

### 7.1 General Design

Due to the fact that the system should be a web application, a modified Model View Controller Pattern (MVC) is used to split up business logic and the user interface presentation. The system has the following components:

Component	Functionality
View	Presents the result of the business logic and triggers the user interaction.
Controller	Handles the communication between view and service in such a way, that the other components do not need to know from each other. The controller processes all transmitted actions from the view and requests the service for the corresponding tasks. The returned information is prepared for the view and presented through the view to the user.
Service	This component holds the business logic of the system and coordinates the interactions with the information components. In the standard MVC this responsibility is held by the controller, the service is introduced to offload this functionality.
Model	Inside the model the information are stored, which are exchanged between all components.
ERP Connector	It is responsible for the communication with the ERP. It has to provide information about documents, customer and the employee that uploaded the document.
Signing Tool Connector	At this component the signing process of a selected document is managed. Therefore, information about the signers are required and the document file.

User Reader	This component handles user and employee data from the company. It is responsible for the login to the system and should store all members of the company with their position. The required information are name, position, phone number and mail address, because they are either needed to give the information, who had to sign a document together with the user based on the rule set. Additionally, it has the responsibility to pass the required signer information directly to the signing tool.
Rules Reader	An important component is the rules reader, because it knows the signing guideline of the company. It provides for the system the information which company positions had to sign a document based on its type, value and the user that initiated the signing process.

Table 7.1: System Components

In figure 7.1 the communication between the components is visualized. In the case the arrows have the description “exchange”, the two connected components transfer information and trigger actions. If the description is “use”, the component the arrow points at is used as a data storage that is transmitted between other components and only stores information. The description “act” means that the user can manipulate this component to reach his aims with the system.

As can be seen the center of the communication is the service component. This corresponds with its functionality to make the complete business logic. Also the model component is only marked as “used” from the other components. That is also explained by its functionality as data storage.

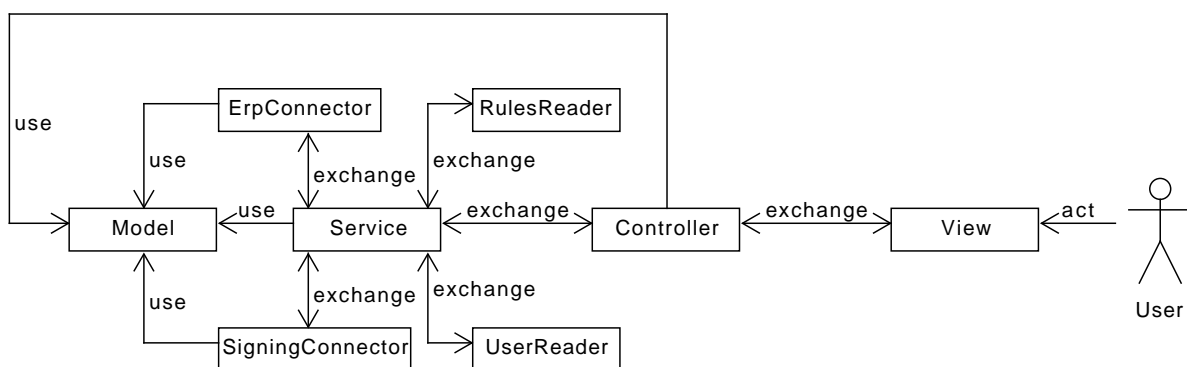


Figure 7.1: General system design

Due to the fact that it is unclear which ERP will be used and that therefore no decision is made for a signing tool, the connector components should be as variable as possible to be independent from the later tools. That leads to the design decision to define interfaces for those connectors, which are implemented with mocked systems to present the process.

Beside these interfaces, two more should be created for the reader components, because those have connections to the data storages, these depend on which company is using the system later on. In most cases they already have an authentication system, that also stores the position of the company members. When implementing the rules reader, the preferences of the later administrators are important, because they are responsible to maintain the data, if changes are made to the signing guideline. Therefore, it is important that they can choose a preferred way to store the data. Following this, the interfaces are explained in more detail.

## Enterprise Resource Planning System Connector

This interface defines the methods for receiving information of documents from the ERP, the document file itself and the storing of the signed document. Therefore the search functionality is especially important for this interface. In general a lot of documents are stored inside an ERP and it is not possible to present them all in a simple overview. At the moment, it should be possible to search for the following information: document type, document name, related customer name and the name of the employee, who created and stored the document inside the ERP.

## Rule Reader

Within this interface only one method is defined, to get the information which combinations of company members have the right to sign the selected document. It will receive the information about the type of document, the value of the document and the position of the user that wants to sign the document. The implementation always follows the request described in section 7.3.

## Signing Tool Connector

This component is responsible for the connection to the signing tool. It has the task to pass all required information for the signing and the document to the tool. Therefore one method exists, which gets that required data inside a container and returns a true or false status when everything goes well or an error occurs. Furthermore, another task exists: To collect signed documents based on their name. This is done within another method, which gets the name of the document and returns a container with all information belonging to the signed document. In the case, that the document is not signed, an empty container should be returned.

## User Reader

Inside this interface different functionalities are defined, which are split up in the areas: position groups and employee information. In the first area the implementation provides the information which employees have a certain position at the company. The second area is responsible for giving specific information about a employee. These information are company position, mail address and phone number.

## 7.2 Used Programming Language and Frameworks

At the start of the implementation a discussion was held, which programming language to use. Available were several options, due to the usage of *DocuSign eSign* for mocking the signing tool. It provides different Software Development Kits (SDKs) for C#, Node.js and Java (DocuSign Inc., 2018j), as well as a Representational State Transfer (REST) API. The choice was Java, because it is one of the standard programming languages of cc and mostly well known by other programmers. Due to the fact that there were time issues at the end of the project, this language was selected.

Another decision was to use *Maven*, because it builds the complete dependencies from the project independently from the Operating System (OS). That is useful for automated testing in pipeline systems and deploying. The decision was made to use *Spring Boot*. With this tool it is simple to setup a project without the need to install a server and deploy a Database (DB). This is beneficial for prototyping, which should be made in this project. Furthermore, it was possible to gather new experiences with the framework and an approach for the

bachelor thesis is to get new experiences. Additionally, *Spring Boot* provides functionalities for security and MVC applications, which are needed in the project.

All other used tools and frameworks are listed in table 7.2.

Framework/ Tool	Functionality
Lombok	Project Lombok is an open source Java library that generates simple code (e.g. Getter and Setters) based on set annotations (The Project Lombok Authors, 2018). It is used to simplify the implementation and make the code structure more clean.
Mockito	Provides functionalities to mock classes and helps to test logic independent from the implementation (Faber, 2018). This functionality is used to test the logic independently from the data storages used in the proof-of-concepts.
H2	This is a lightweight Structured Query Language (SQL) DB with an already existing API for data transferring between system and DB. Furthermore, it is developed based on the programming language Java. (H2, 2018) Inside an H2 DB the rule set will be stored.
JUnit	This framework provides a lot of functionalities for testing like test suites or specific annotations for testing (tutorialpoint, 2018).
Thymeleaf	A template engine for web applications to easily exchange data from <i>Hypertext Markup Language</i> files with <i>Java</i> classes (The Thymeleaf Team, 2018). Specifically usable for the MVC.

Table 7.2: Used Frameworks

### 7.3 Rule Set Request

Inside the rule set the signing guideline is stored for the system. In general it can be said that there exist four general data sets:

- Company positions:  
Inside this data set all the positions of a company are listed. Each of them has different rights and liabilities.
- Document types:  
At a company several different document types exist and they need to be handled differently regarding the signatures.
- Value ranges:  
In a signing guideline several different value ranges are listed. They are inserted in this data set. Each of them has a minimum value and a maximum value.
- Signing groups:  
Inside a company several signing groups exists, which consist of different company positions. Each group has combined rights.

The rule set is a combination of the previously explained data sets. It defines for each document type and the corresponding value ranges which signing group is allowed to sign the combination.

In the situation a user selects a document for signing, the system needs to analyze based on the document type, the value of the document and the position of the user. If the user is allowed to sign at all, it has to be checked if there are other company positions that need to sign along.



The mathematical presentation of this request is presented in the appendix D. The following figure 7.2 visualize the process. In the first instance it has to be checked that both the document type and the position

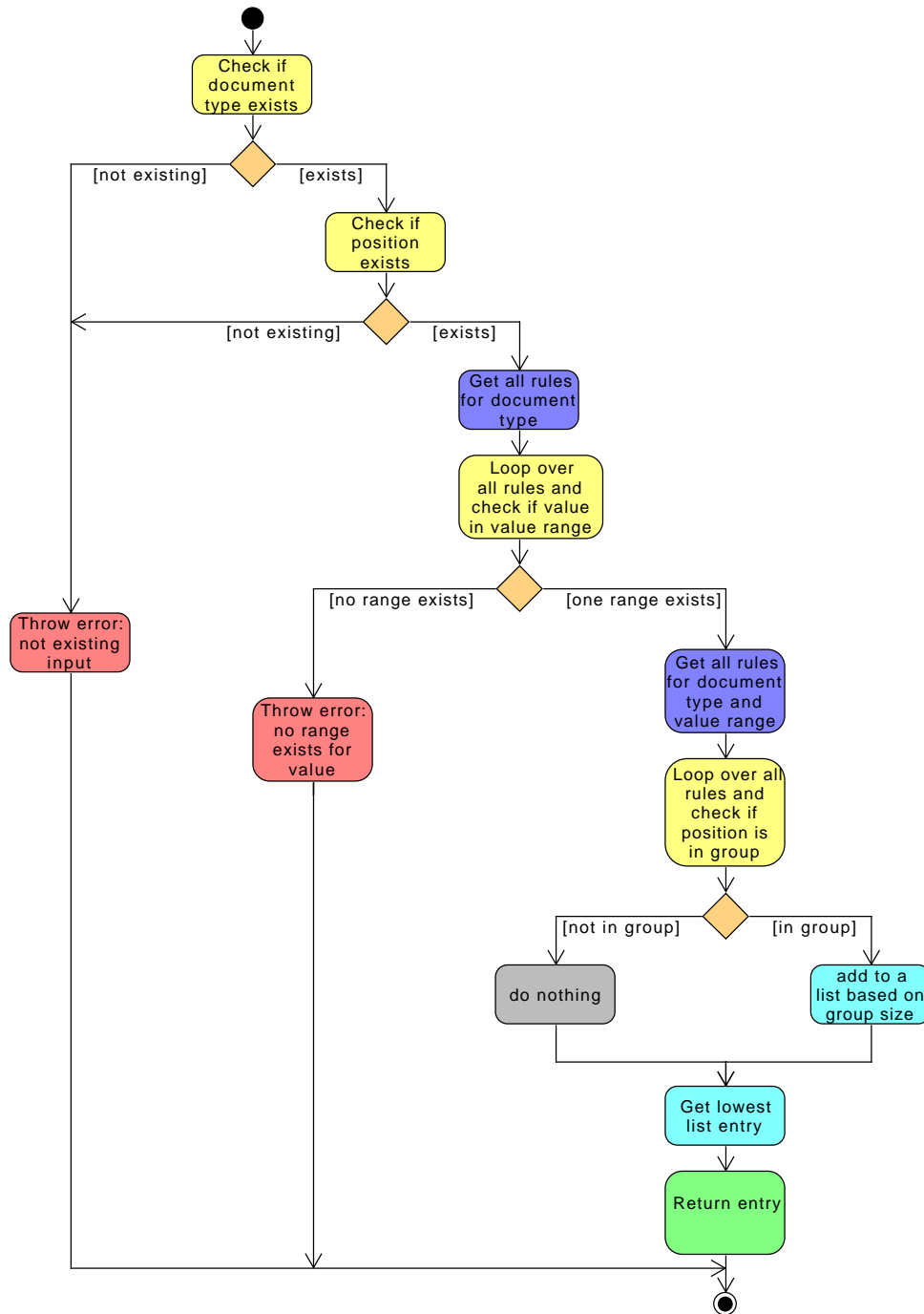


Figure 7.2: Process of rule set request

exist inside the data sets, otherwise an exception is to be thrown that informs the system about the invalid information. Next all rules regarding the specific document type should be collected from the rule set data. Inside this, the different value ranges need to be fetched. For each of these value ranges, the minimum and maximum are gathered and it is checked if the given value for the request is between those two. If there is no match an information is given to the system via an exception. Else all signing groups from the rule set with

the specific document type and value range are called and it will be proofed whether the use position is inside this group or not. In the situation, that the position of an employee is inside the signing group, the system should add the signing group to a list based on the group size. If the user is not in the group, nothing should happen. Finally, the groups with the smallest size should be returned. In the scenario that there is no signing group at all, an empty list should be returned, which signalizes that the user does not have the permission to sign the document based on the signing rule set.

### Example

For a better understanding an example is given based on the signing guideline from cc presented in table 5.2: The general data sets:

- Company positions: employee; salesman; manager; procurator; chairman
- Document types: quotation; NDA; contract
- Value ranges: 0 - 50 000; 50 000,01 - 400 000; 400 000,01 -  $\infty$ ; 0 -  $\infty$
- Signing groups (extracts): employee only; manager only; salesman with manager; manager with chairman; ....

For the rule set example an extract is selected. In the following the entries are presented:

1. Contract; (0 - 50 000); salesman alone
2. Contract; (0 - 50 000); manager alone
3. Contract; (0 - 50 000); chairman alone
4. Contract; (50 000,01 - 400 000); salesman with manager
5. Contract; (50 000,01 - 400 000); salesman with chairman
6. Contract; (50 000,01 - 400 000); manager alone
7. Contract; (50 000,01 - 400 000); chairman alone
8. Contract; (400 000,01 -  $\infty$ ); salesman with chairman
9. Contract; (400 000,01 -  $\infty$ ); manager with chairman
10. Contract; (400 000,01 -  $\infty$ ); chairman alone

## Chapter 8

# System Implementation

Within this chapter the concrete implementation of the proof-of-concept is explained. First of all the core system implementation is described, followed by the implementations of the interfaces defined in the previous chapter.

### 8.1 Core System

The system is a web application, which could be deployed on a server. During the development phase it runs on a local machine. The functionality available to the end-user is limited due to time constraints. First of all a security layer is added, where the user has to log in to the system. Therefore, a security implementation of *Spring Boot* is used, that creates the layer automatically after the configuration. For the authentication a Lightweight Directory Access Protocol (LDAP) server is used, which is also used for the user management explained in section 8.2.

When the user is logged in, he gets redirected to the main page. A view that contains a search box, a table that presents the search results and buttons for searching and signing. At the current state only the search functionality and presenting the search results are implemented.

With the help of *Thymeleaf* it was simple to connect the view to the controller. Within the view also a bit of logic is added e.g. for displaying a table with a variable row size.

As defined in the design, the controller does not have any business logic inside. Every time an action needs to be performed with business logic, it calls the service of the application. It only stores the data needed to be presented in the view.

The service coordinates the business logic, as well as the interactions with the external components as defined. At the moment the implementation of external components, which are explained in the following sections, are added to the core system hard coded. That means inside the service, classes implementing the used interfaces, like the *Rule Reader*, are explicitly declared inside the controller. That should be replaced by a more dynamic way. Suggestions therefore will be made in chapter 9.

A dynamic solution exists at the moment for the model implementation. It is defined that every document type has a different tag, that is identified within the name of the document type. For the representation of the document type within the model, a special *Java* data type was selected: a so called *Enum*. It defines constant values for objects (**enum2048**), in this application the document types: quote, NDA and contract. Within this data type a variable tag exists, that is read from a properties file. The following code snippets will show it:

```
tag = (String) properties.get(this.toString());
```

Listing 8.1: Reading of tag from document type

```
QUOTE=A-*
NDA=N-*
CONTRACT=C-*
```

Listing 8.2: Properties file for document type

The application reads the tag from the properties file. Important to note is, that for each defined constant of the document type the same name needs to exist within the declaration of the data type and inside the properties file. Otherwise the system gets broken.

The “\*” in the code snippet 8.2 symbolizes a placeholder for an undefined amount of letters that comes after the symbol. In the case the tag is in the middle of the document name it could look like this: “\*-A-\*”.

## 8.2 User Management

For the user management system, which is used by the component user reader, the decision was made to use a LDAP server. This is done, because currently cc uses a LDAP server to authenticate their member access to their other used systems. Furthermore, *Spring Boot* offers already implemented methods and classes to easily connect a system to a LDAP server. An alternative was to create a complete new user management. But to reduce the amount of accounts for the users and keep the login consistent the decision was made to use the LDAP server. Furthermore, it reduces the complexity of the system according to security aspects for the login, by using standard technologies.

To avoid problems with the live LDAP server of cc, a prototype LDAP server is created. Therefore, an embedded LDAP server is used, which is generated each time the created *Spring Boot* application is started. This leads to the advantage, that no extra server needs to be set up and maintained.

The LDAP server structure is presented in diagram 8.1. At the moment there is a different structure than the one existing on the live server. The structure is similar to an Extended Markup Language (XML) file. At the beginning of the file a root node needs to be declared. In this case its name is “codecentric”. Afterwards other elements could be added, so called *Organizational Units*, which are grouped beneath the root node. Inside this implementation only two elements exist: “groups” and “people”. Inside this node additional nodes are placed. For the node “groups” the different possible positions are added as node with the members of the specific group listed. Within the “people” node the member of the company are stored with additional information like name and mail address. At the moment there are only test data inserted. An extract can be seen in appendix G. This is useful for testing prototypes and present them to potential customers without presenting protected data of cc.

The connection to the server is done with *Spring Boot*. Therefore three components are needed: A configuration class, entity classes that represent the different elements stored at the server, and repository interfaces that define the requests, which are made to the server regarding a specific entity. The complete class structure can be seen in figure H.1.

Due to the fact that an embedded server is used, it is not possible to test the logic with data from the LDAP server without starting the complete application. Therefore, the server connections, which are represented through repositories, are mocked with the framework *Mockito*.

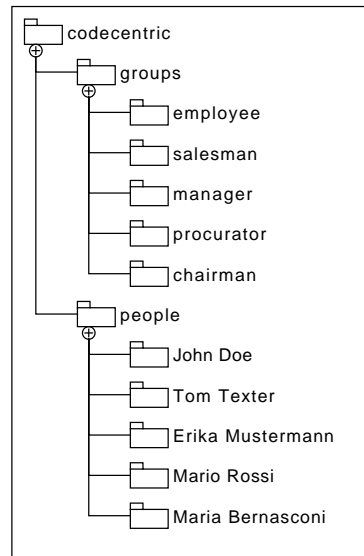


Figure 8.1: Structure of the Lightweight Directory Access Protocol Server

### 8.3 Enterprise Resource System Connection

Due to the fact that there is currently no ERP available, the decision was made to simulate it completely. Therefore, the implementation generates test data and stores them inside lists. Furthermore, only one file for signing is available, which is used to simulate all document types that should be processed inside the current project. Within the data it is ensured, that all possible scenarios could be simulated based on the new signing guideline presented in table 5.1.

As test data for the company members, the same user names as in the user management are used to keep the data consistent for the complete system.

The testing of the logic has a simple structure, due to the fact that nothing needs to be mocked. But due to time constraints not all functionalities given through the interface are implemented, because until now they were not part of the *User Stories* that should be implemented. The methods for getting the document itself and to store the signed document are not implemented and tested.

### 8.4 Rule Set

For the rule set implementation several options exist to store the signing rules. For the prototype, the decision was made to do it with a SQL DB, instead of using a file with *JavaScript Object Notation* or an XML file. The reason is that *Spring Boot* offers the possibility to use an embedded SQL DB. Therefore, two files need to exist in the resource directory of the application: a SQL schema and a data SQL file. For an XML data storage three files need to be created: a schema, a data type and a data file. Furthermore, a complete XML reader needs to be developed to read the stored data. Therefore, the decision was made to use a SQL DB.

With the usage of an embedded DB the setup work of the application is reduced, due to the fact that the *Spring Boot* application always creates the DB when starting the application. This leads to the benefit that no extra DB server needs to be created and set up, even in the situation a demonstration is given on a different computer.

As DB engine *H2* is used, because it was advised by employees of cc that often work with *Spring Boot*. The

benefit is the *Java* based implementation of it, so that no extra software need to be installed beside of *Java*.

The figure 8.2 presents the schema of the DB structure in an *Entity Relation Diagram*. Differently from the design described in section 7.3 there are six tables instead of five, but this is related to the constraints given through a relational DB and a SQL DB is mostly a relational DB (Codeacademy, 2018). The sixth table is the connection for the signing groups positions. In general the stored information should be simple structured to identify the different rules and related data.

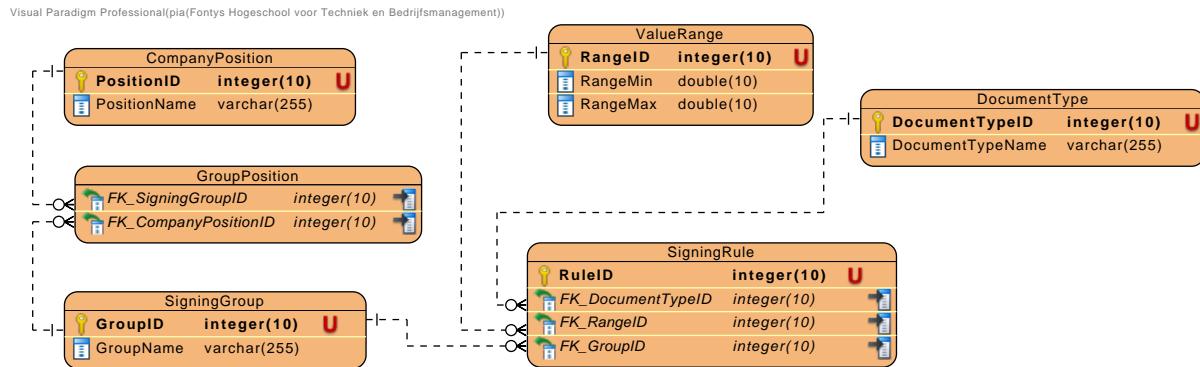


Figure 8.2: Entity Relation Diagram of the Rule Set Implementation

Besides the data storage, an implementation of the described algorithm from section 7.3 is done. The complete class structure can be seen in figure H.2. In general the code follows the structure given by the defined algorithm shown in appendix D, but at one point it has a customization. That is at the point in which the signing groups are sorted based on the size of the group.

Inside this implementation no direct sorting is done, because that would take too much time and resources. Instead the option was developed to have an integer that represents the current minimum group size and a list that stores the groups with the smallest size. At the beginning of each new request it gets the highest integer value possible in the *Java* environment. Then the following code is executed:

```

if (compareList.size() < curent_min) {
    curent_min = compareList.size();
    returnList.clear();
    returnList = iterateOverList(returnList, compareList);
} else if (compareList.size() == curent_min) {
    returnList = iterateOverList(returnList, compareList);
}
  
```

Listing 8.3: Store signing group based on its size

The *returnList* is the list that stores the signing groups and *compareList* contains all positions of a signing group. The method *iterateOverList()* only requests the name of the positions belonging to the group, because they are given previously with their identification number and for the later processing in the core system the name is required.

In the case that the group size is smaller than the already stored value, all previously stored groups will be removed from the list and the smaller group is added. Otherwise if the size is equal to the current smallest groups, the group will be added to them.

Important to notice is, that it is expected, that there is no overlap within the different value ranges given to one document type, because the implementation does not care about this and takes the first value range that fits

the requirements.

Another important aspect to show up is that the tests also have to be mocked, because the used embedded DB is only created at the start of the complete application. This is one big disadvantage by using an embedded DB. For testing the framework *Mockito* was used to mock the classes representing the connection to the DB. But due to a complex data logic the mocking of the data was extended and the effort the same as creating a complete new DB with a new stored data set.

## 8.5 Signing System Connection

For the prototype a connection to the *DocuSign* tool should be created. A developer accounts exists which could be used for development and prototyping. Therefore, an account needs to be created for free so the SDKs or the REST API can be used. But the constraint is, that it is only send to a demo environment and the received documents will be branded as such, and therefore are not approved by the law (DocuSign Inc., 2018i).

Due to time issues there will be no implementation, because the general setup with the previous requirements took more time than expected. But instead an advice will be given in chapter 9.

## Chapter 9

# Recommendations

Within this chapter recommendations for the further implementation and improvements of the prototype are given.

Therefore, it is split in two parts according to the general structure of the system: the core system and its external components.

### 9.1 Core System

For the core system it is important that all requested functionalities will be implemented. This means, the user should have the possibility to:

1. Select a document for signing
2. Select a signing group if needed
3. Select a specific person, which has the required position based on the signing guideline
4. Send the document for signing
5. Store a signed document

To implement the first point only changes within the controller and the view component need to be done. The logic is already implemented inside the service component. Within the controller two methods need to be created that coordinates the information exchange and the selection of a document. Inside the view the corresponded buttons and tables functionalities need to be added.

For the items two and three only connections and the presentation need to be implemented. No specific implementation needs to be done within the “external” components. Therefore, the logic needs to be created within the service for example request for members of a specific position group or asking for the signing groups that are required to sign the document. Within the controller and the view component the communication methods and corresponding view elements need to be added.

Within the last two items, more changes need to be done at the current state of the prototype. For them the signing system connector needs to be implemented and the ERP connector enhanced, because currently it does not provide the functionality to return unsigned documents and store signed documents. Furthermore, a convention needs to be developed for the storing documents regarding the naming of the signed documents and the place of storage.



All the items could be found inside the product backlog, which is added in the appendix F. The items that do not need to be implemented are the functionalities of adding new users or changing passwords. The reason for this is the usage of a LDAP server, where the user data are stored. In most cases the companies and their system administrators have another tool or framework to add users or change passwords.

## 9.2 User Management

Within the user management an additional security should be added. At the moment a deprecated method is used to authenticate users. That should be changed to increase the security level.

Another important aspect is the implementation of the request for the phone number of a company member. To increase the security level within the signing process, the signing tool may request the phone number of the signer to identify it with an additional code send to the mobile phone.

Furthermore, it should be possible to make the login independent from a LDAP server. In case the customer wants to have another user management, it should be possible to change that via a property.

## 9.3 Signing System Connection

For the *DocuSign Java* client SDK no concrete documentation exists. The only information available is beneath the following link: <https://github.com/docusign/docusign-java-client>. The instructions given on that page should be followed for the implementation. Due to the fact that the system will not work with templates, which are predefined general documents where only a few information need to added, a different handling needs to be done.

The class implementing the interface needs to determine where to place the signing fields within the document. Therefore, a research should be done to identify the best solution. It is possible that there exists already solutions for either with another tool, a *Java* library or code.

## Chapter 10

# Conclusion

At the beginning of the project the plan was to create a CMS with the possibility to sign documents electronically. In the first planning a different customer, *Wacom*, was bet on. That changed, because they did not finish the development of the SDK the project should work with. Then it was decided to work for cc, because at this moment they do not have a CMS and they wanted to increase the usage of ES.

Within their current process they have several problems. The biggest aspects are the amount of manual work that needs to be done with the documents and the issues with the fulfillment of the outdated signing guideline. To remove the problems, a new process should be created that fulfills the goals of the new signing guideline and reduces manual work and paper usage at cc. To introduce and assist the employees to get familiar with the new process, an application should be created, that helps to fulfill the signing guideline with an ES and coordinates the document storage of signed documents.

Due to the circumstances of high license costs for the signing tool usage and the introduction of a new ERP, the decision was made to create a prototype, to simulate and check if the application will support the new process. Moreover, it is possible to build the prototype in such a way that it can be combined with any ERP a company has, as long as it has an API to communicate with. It should be as flexible as possible.

During the implementation phase time constraints occurred, that lead to the fact that most functionalities required for simulating the new process are not implemented. It is advisable to pursue development and regularly check the value of the system. But therefore cc should wait until they know which new ERP they get, because there exist a lot of signing tools that are available as plug-in for some ERPs. It will reduce costs regarding the development and deployment of an own application when they can be connected easily. The only aspect, which needs to be taken into account, is that they may need to make a separate plug-in for checking the signing regulations based on the signing guideline.

In the case no plug-in exists for the new ERP, the created prototype should be completed and tested for the production at cc.

In general it needs to be said, that this bachelor project was not executable as planned due to external circumstances. But this could happen with every project that is executed in the working environment of a company.

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## **Appendix A**

# **Business Sub Process Models of the Old Process**



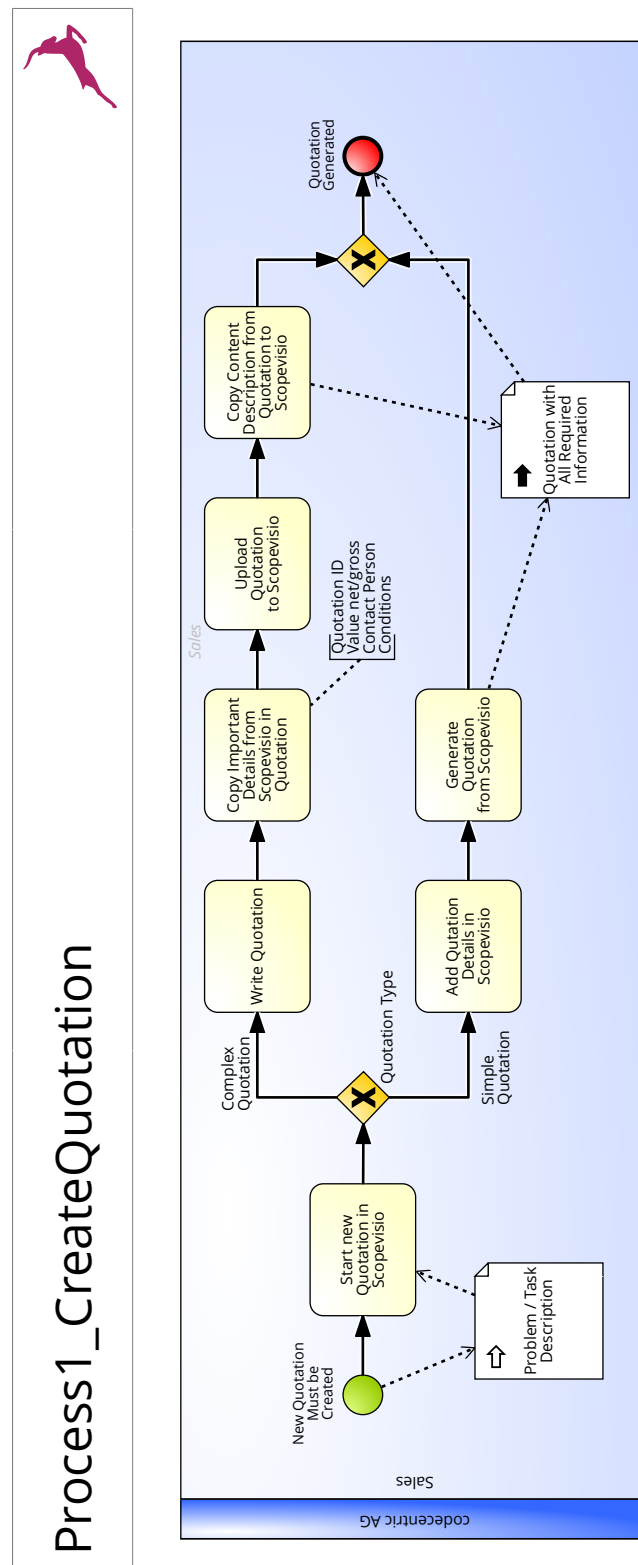


Figure A.1: First Old Subprocess - Creation of a Quotation

## Process2\_SignQuotation

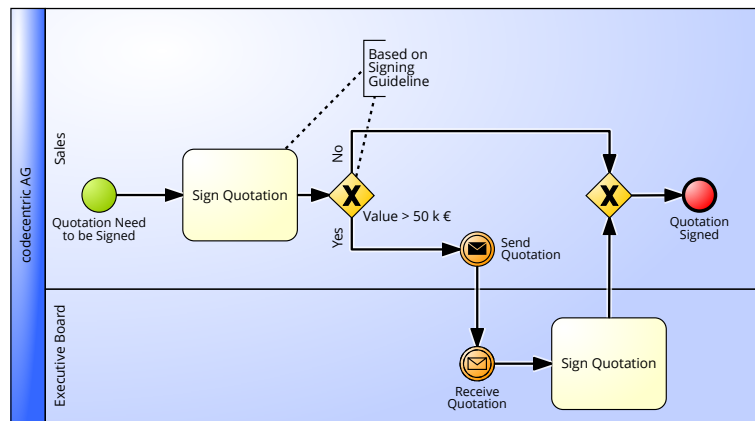


Figure A.2: Second Old Subprocess - Signing of a Quotation

## Process3\_ApproveOrder

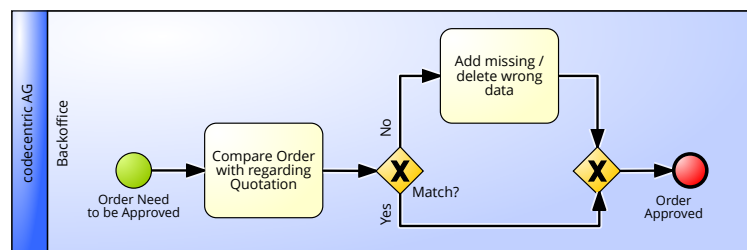


Figure A.3: Third Old Subprocess - Approve Order

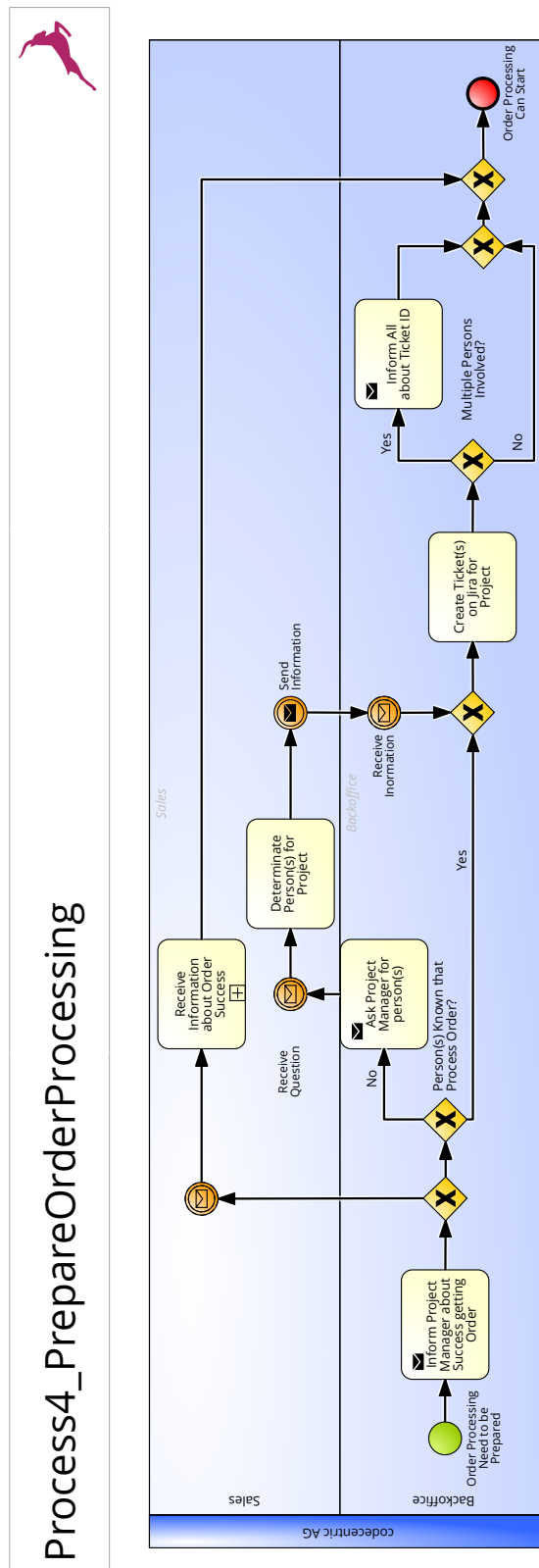


Figure A.4: Fourth Old Subprocess - Prepare Order Processing

## Process4\_1\_ReceiveInformationOrderAccepted

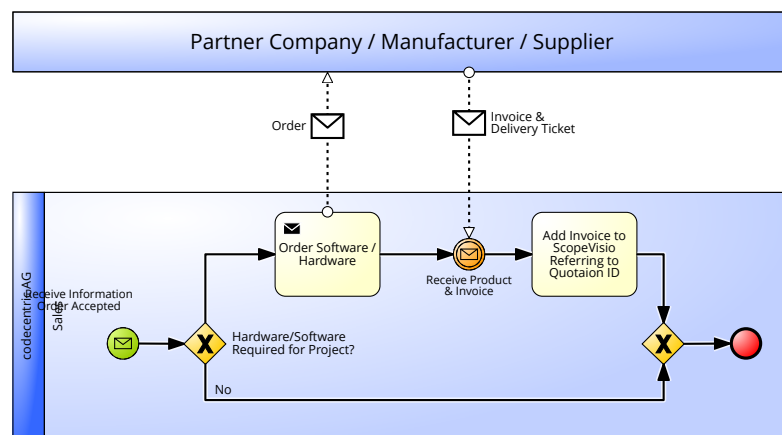


Figure A.5: First Old Subsubprocess - Order Needed Hardware and Software

## **Appendix B**

# **Research about Electronic Signature**

### **B.1 Introduction**

At cc a paperless office should be introduced. That means all contracts and offers possible should be signed and archived in digitally way. Currently for some contracts a tool is used to sign documents digital, but that should be extended. Also, the archiving is done digital, but in a manual way with scanning of the signed documents and then uploading them to the archive. 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 "digital signature" and "ES". In this document there will be a difference. The "digital signature" 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 states in the EEA (Bundesministerium 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. 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. Additionally 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 exists 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 digital signature, also called hash, of the document to be signed.
2. The digital signature is encrypted through the private key of the signer and not the complete document. In the most cases the encrypted digital signature is added to the document.
3. The signer sends the document and the encrypted digital signature to the contract partner.



4. The contract partner receives the data.
5. The contract partner decrypts the encrypted digital signature.
6. The contract partner calculates on its own the digital signature of the received document.
7. The contract partner compares the calculated digital signature with the decrypted digital signature. Depending on the results two situations could occur:
  - (a) Both digital signatures 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 digital signatures 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 digital signature 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 digital signature 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	2	0	0
Total sum	6	9	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 ?? is that the QES fits the requirements explained in section ?? 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.

## Appendix C

# Research about Signing Tool

### C.1 Introduction

Due to the fact that cc will introduce a paperless office, all possible documents should be signed electronic. Therefore, several tools already exist. Inside this research a market research should be done about the topic which tool will fit best the requirements.

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 advise 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.

### C.2 Scope

The scope of this research is to figure out which tool for electronic document signing fits best the requirements given from the company cc. Due to the fact that there are many tools available only a selection is done. From the company the tools *HelloSign* and *DocuSign*, solution from partner companies and the solution from the company *Wacom* should be taken into account. Additionally, other tools will be taken into account, but this is only a selection based on an internet research. How this is been done, is explained in the next section.

### C.3 Questions

In this research the question will be answered which available tool or technology fits best the requirements of cc to sign documents electronically to work more efficient. The question will be answered through an internet research. Tools will be selected based on the information of different comparison portals and the information provided by the company itself. Furthermore, there will be some testing of the functionalities if possible to prove the usability for cc.

For the testing of the functional requirements like order of signing and the simple usage the preset up is to creation of three test mail addresses and three documents of the format PDF, Microsoft word and Open Office writer. The real testing is based on the following steps:

1. Register with master mail address to the tool.

2. Upload the document.
3. Enter other mail address to sign document.
4. Select order of signing if possible.
5. Add fields to sign if needed.
6. Add company stamp if possible.
7. Sign document with master mail address.
8. Release document for other mail addresses.
9. Do one of those steps:
  - (a) Try to sign against order.
  - (b) Try to decline of document signing.
  - (c) Sign document with unknown account.
  - (d) Sign document with known account.
10. Check current state of the process.
11. In the case the document is signed by all, check the availability of the document and download it.

## C.4 Criteria & Weightings

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

- Integration

Weight: 8

The most important criterion is the integration, because the tool should be interact with the ERP and the Google Suite used by cc. In the best case all the tools can be used in one system. This means they are in such a way integrated with each other, that the end user do not need to switch the applications.

This criterion is a knockout criterion. In the case it is not fulfilled the tool will be automatically ignored for the process realization.

- Device independent

Weight: 7

Due to the fact that all employees of cc have different OS for their computer and smart phones, should be the tool hardware independent. Furthermore, it is stated that the employees and execution board is not always at the buildings of the company available, doing home office or working by the customers. This leads to the preference of having App for the tool, so that the employees of cc can sign the documents everywhere they are independent of their device available.

This criterion is a knockout criterion. In the case it is not fulfilled the tool will be automatically ignored for the process realization.

- Usability

Weight: 6

Another requirement is the usability. For the reason that several employees should use the tool, it need

to be simple to use. There should be no long learning time and the handling need be intuitive or at least the tool should provide information about buttons or next steps. In the best case the tool has a lot of automated processes, so that the user do not care about what to add where and with which information.

- Costs

Weight: 5

It is important to have the costs in focus. If they are too high the cost-benefit ratio will be negative and the effect of the new process for cc is non existing. The areas pricing model, access to functionalities and amount of accounts fall into this category. For this research price information for 2.400 documents and 80 users should be collected and then calculate this price for one document to get information about the price per document. The classification should be done based on the average of all tools taken into account.

- Accepted file formats

Weight: 4

Cc uses in general three different file formats for their documents. It should with the tool possible to use them in the future with the tool to sign the documents without converting them into another format.

- Operating mode

Weight: 3

Another criterion is the operating mode. That means runs the tool as Software as a Service (SaaS) or On-Premise (OP), need cc provide its own server and need to care about its security and backup or does the provider of the tool offers this within his plan. This influence also the costs of the tool.

- Additional security

Weight: 2

To be sure that the correct person use the service and to increase the security, cc uses the Two-Factor authentication for most systems and tools they use. This should be also available for the signature tool.

- Legal aspects

Weight: 1

The tool should satisfy certain legal standards, so that cc could be use the signing as evidence. This is also important in respect to further use cases for the tool at cc, where a higher standard exist than for quotations.

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

Criterion	Category	Weighting
Integration	No	- -
	Tools for workflow building	o
	Predefined integrations for some tools at cc exists already	o
	API and/or SDK	+
	API and/or SDK & predefined integrations for some tools that are already in usage	+ +
	Predefined integrations for all tools used at cc	+ +
Device independent	Additional hardware required	- -
	Only for certain OS for Desktop	- -
	Only for certain OS for smart phone	- -
	Only for Desktop	-
	Only for smart phone	o

	Only for programmed devices	o
	Only web application	+
	With web application and for all OS of smart phone and Desktop	++
Usability	A lot of actions to set required fields & activate sharing	--
	A few actions to set required fields & activate sharing	o
	A few actions to set required fields & activate sharing & company stamp can be recorded	+
	Recognize where to set fields	+
	Recognize where to set fields & company stamp can be recorded	++
Costs	$> +25\% \emptyset$	--
	$> \emptyset \& \leq +25\% \emptyset$	-
	$> -25\% \emptyset \& \leq \emptyset$	o
	$> -50\% \emptyset \& \leq -25\% \emptyset$	+
	$\leq -50\% \emptyset$	++
Accepted file formats	Special type	--
	PDF	o
	PDF & Microsoft Word (doc, docx)	+
	PDF, Microsoft Word & Open Office Writer(odt)	++
Operating mode	OP	o
	SaaS	++
Additional security	None	--
	Question and Answer	o
	Online identity	o
	Authentication with mobile phone	+
	Authentication with video, personal ID or similar	++
	Certification	++
Legal aspects	No	--
	eIDAS fulfilled with SES	-
	eIDAS & fulfilled with SES	o
	eIDAS & fulfilled with AES or QES	+
	eIDAS & fulfilled with AES or QES & global accepted	++

Table C.1: Categories and their weighings

## C.5 Result

In this section different tools will be described, their test result presented and the general information of them summarized.

### C.5.1 Wacom sign pro PDF

This tool is provided by the company Wacom, which is the customer previously thought for the bachelor project. At the moment there is an App available, that signs documents with a BS (Wacom, 2018a). Currently Wacom develops an SDK based on the App, therefore is no testing possible. The information presented in table C.2 are from the internet and a product presentation from first March 2018 at the Wacom site in Düsseldorf.

Due to the fact that the knockout criteria are not fulfilled at the moment, no further research was done.

Criterion	Fulfillment
Integration	This year a new SDK will be published that allows the integration with existing tools at cc.
Device independent	The usage of this technology requires hardware at the moment. Therefore, several options exist. Either you have a smart phone with a pen, an iOS phone, a Windows computer with touch recognition or a Windows computer with additional hardware.
Usability	
Costs	
Accepted file formats	
Operating mode	
Additional security	
Legal aspects	

Table C.2: Summary Wacom sign pro PDF

### C.5.2 DocuSign

This tool is already in usage at cc, but not always and with a lot of manual actions and missing things like the company stamp. During the testing a lot of functionalities were figured out. The test protocol is placed in the appendix C.8. The table C.3 below will give a short summary about the test result and other aspects figured out during the research.

Criterion	Fulfillment
Integration	A SDK available within the “Business Flex“packet of the provider or a higher one. Also an integration is possible with Google applications and JIRA, which are both used by cc. (DocuSign Inc., 2018e; DocuSign Inc., 2018l; DocuSign Inc., 2018k; DocuSign Inc., 2018d).
Device independent	Online available, also an App is accessible for all OS of smartphones (DocuSign Inc., 2018o). It provides the same functionalities as the web application.
Usability	The fields need to be set manual, it need to be checked if it possible to customize it. Furthermore, it is possible to track activities, assign signer, add the company stamp, transfer the signing responsibility, decline the signing and to sign the document manual and scan it then.



Costs	The signing itself costs nothing. The cost per year will be 11.823,00 €. Included is the API and web application access, support, unlimited users and signers and a document retrieve. This leads to an average cost for one document of 4,93 €. The document retriever is included in this calculation, but due to the fact that this functionality is optional the price excluded of it is 3,37 € per document and this is taken into account for the later comparison to have a similar base for all tools. Additionally, an on-boarding is offered for 1.250,00 € (Appendix C.16). Documents, which are unused, will be expired. In the case the amount of documents is expended before the years end, it is possible to order new one.
Accepted file formats	PDF & Microsoft Word accepted, Open Office Writer is not accepted. Moreover, the maximum accepted size of a file is 25 Mega Byte (MB). (DocuSign Inc., 2018l)
Operating mode	The tool is as SaaS, OP or a combination of both available. (DocuSign Inc., 2018m; DocuSign Inc., 2018b)
Additional security	Access code, Short Message Service (SMS), phone call or certificate exists for multi-factor authentication. Moreover, a knowledge based authentication is available, where an information from the past of the signer is requested. (DocuSign Inc., 2018a)
Legal aspects	DocuSign satisfies the standards of the eIDAS, with the all ES types mentioned in it, and more security standards (DocuSign Inc., 2018n; DocuSign Inc., 2018h; DocuSign Inc., 2018g). Moreover, it fits to the data legacy of most countries worldwide and implemented the regulations of the GDPR (DocuSign Inc., 2018c; DocuSign Inc., 2018f).

Table C.3: Summary DocuSign

### C.5.3 HelloSign

The online tool HelloSign is used at the subsidiary company Istana of cc. Therefore, it should also taken into account. Not all functionalities could be tested through the fact that for the business version data were requested, the tester was not allowed to give. The result of the test is documented in appendix C.9 and a summary of it together with additional information collected from an online research is given in table C.4.

Criterion	Fulfillment
Integration	HelloSign has an API with different version provided, included there are several functionalities. Moreover, integration exists for Google services like Google Suite and for several other business applications e.g. HubSpot CRM or Slack, which are used at cc. Additionally, third party integration is possible with Zapier, a tool for modeling business processes. (HelloSign, 2018d; HelloSign, 2018g)

Device independent	The tool is online available. Furthermore, exists an App for Android and iOS, but it has not the same functionalities as the online platform. It allows only the scanning of documents and sign them. (HelloSign, 2018e)
Usability	It is simple to upload a document and sign it, due to the fact that there is intuitive handling. Not all functionalities like branding and company stamp could be tested, because of the non usable test version of higher plans. The fields required for signing need to be set manual and there is not that much choice of fields. In the case the App is used, only the creation of a signing process could be done.
Costs	Signing without costs is possible, but the creation and preparation cost. To use the API and the web application the API Gold Plan and the enterprise web app plan need to be paid. This will costs normally 28.420\$ per year. Included are 80 users, 450 documents sending per month and unlimited support. The cost for one document will be then 9,48\$, which is 7,92 €calculated based on the exchange rate from the 14th May 2018. C.17
Accepted file formats	HelloSign accepts several file formats. In the test the formats PDF, Microsoft Word and Open Office Writer was accepted. The maximal amount of pages from a document are 500 pages or a file size of 40th MB (HelloSign, 2018f).
Operating mode	In general the system is available in SaaS mode. (HelloSign, 2018c)
Additional security	To verify the authentication HelloSign has two options: the two-factor authentication and the password protection signature request.(HelloSign, 2018a)
Legal aspects	The tool fulfills the requirements of the eIDAS and GDPR from EU and can be used in the United States of America (USA) (HelloSign, 2018e; HelloSign, 2018b).

Table C.4: Summary HelloSign

### C.5.4 SignDoc

This tool is provided by Kofax, a partner of cc. But due to the fact, that the testing was not possible through installation and runtime problems, the test was canceled and no further research is done, because of the not fulfillment of one knockout criteria.

Criterion	Fulfillment
Integration	There is an SDK available (Kofax Inc., 2018).
Device independent	It should work most OS (Kofax Inc., 2018), but for the testing there were big problems to get it runnable on Windows and Linux OS. Moreover, the browser plug-in was not accepted by the browser Google Chrome and Mozilla Firefox. Additionally, an App exist, but it did not run without errors on the test smart phone.
Usability	

Costs	
Accepted file formats	
Operating mode	There is only an OP solution available.
Additional security	
Legal aspects	

Table C.5: Summary SignDoc

### C.5.5 Adobe Sign

This tool is a very popular, which is online available. There is a test version for the business plan, which was tested. The protocol is documented in the appendix C.10 and the information gathered from the internet research are summarized in table C.6 below.

Criterion	Fulfillment
Integration	Adobe offers in the enterprise plan an API and has already a lot of integration with other tools like Microsoft and Google (Adobe, 2018g; Adobe, 2018a). Furthermore, an API is available (Adobe, 2018c).
Device independent	The tool has a web application and an App for Android and iOS. It has the most functionalities as the web application.
Usability	Adobe created a tool which is simple to understand and use. The requested functionalities are all available and intuitive usable. Only a few actions need to be made manually to prepare a document for signing.
Costs	To use API, the business plan is required, but Adobe did not send any information or called the student. Therefore, no information is available.
Accepted file formats	The tool accepts file formats PDF, Microsoft Word and several different images formats (Adobe, 2018a).
Operating mode	Adobe Sign runs as SaaS. (Van Eeckes, 2016)
Additional security	Multiple methods exist to check the identity of the signer: signing password, knowledge-based authentication, Web-identity authentication, phone authentication and Adobe Sign authentication. (Adobe, 2018f)
Legal aspects	Adobe Sign fulfills the requirements of the eIDAS and the GDPR and can be used also in the USA. Available are all ES types mentioned in the eIDAS. (Adobe, 2018e; Adobe, 2018b; Adobe, 2018d)

Table C.6: Summary Adobe Sign

### C.5.6 SignNow

SignNow is one of lower-priced ES tool available. With the test version of the functionalities and process of it are tested. The test is minuted in the appendix C.11 and the information collected from the internet research are pooled in the table C.7.

Criterion	Fulfillment
Integration	The developer of SignNow provides an API and created already integration to other tools like the Google Suite (PDFfiller Inc., 2018b; PDFfiller Inc., 2018d).
Device independent	SignNow is an online application, therefore available on every computer with internet connection. Moreover, exist an App for the OS iOS and Android.
Usability	The tool fulfills most of the requested functionalities excepted the company stamp, instead some other features are available. But inside different browsers another guidance is given. Moreover, the fields need to be set manually.
Costs	Based on the information received from the sales of SignNow, it will cost around 2.000€/year for 2400 documents/year. The costs for one document will be around 0,83 €. But there is no information available if there are the usage of the web application is included.
Accepted file formats	On the internet there is no information available regarding the acceptance of document types. The document types tested based on the scenario described in section C.4 are accepted.
Operating mode	SignNow is as OP available, but in general as SaaS. (PDFfiller Inc., 2018e)
Additional security	Three types for the authentication are provided: document password, dual factor authentication and phone call authentication. But there might be the problem that some of them are not available outside the USA. (PDFfiller Inc., 2018a)
Legal aspects	SignNow fulfills the requirements of eIDAS and the GDPR. That leads to the fact that they are allowed to be used in the EU. Regarding the circumstance that the tool was developed in the USA it is also usable there (PDFfiller Inc., 2018c). There is no information available regarding the used ES types. Therefore, it has to be assumed that it offers only the SES signature.

Table C.7: Summary SignNow

### C.5.7 eSign Live

Another tool that is taken into account is eSign Live, which is owned by the company VASCO and is placed in Canada. The test result is shown in appendix C.12 and the result from the test impression and internet research is summarized in table C.8.

Criterion	Fulfillment
Integration	In the enterprise plan of the tool an API is provided. (VASCO, 2018a)
Device independent	eSign live is a system, that has a web application and has Apps for iOS and Android, which have the same functionalities as the web application. (VASCO, 2018a)

Usability	The tool is simple to use and has the most functionalities requires by cc. Only the declining functionality and the company stamp option are not available. Moreover, are other functionalities available like the in-person signing. Both, the App and the web application are intuitive usable.
Costs	The usage of the API and SDK with 2400 documents per year will cost 5.640 €/year. This is the enterprise plan. In the case the web application is also used it will cost 13.680 €/year. To compare the tool with other tool it need to be sum up, which leads to a sum of 19.320 €/year. The costs for one document are 7,63 €. The information are from the support of the tool. C.18
Accepted file formats	Tested and accepted are PDF, Microsoft Word, Open Office and JPG formats. There exists no information online.
Operating mode	The tool is completely available as SaaS.
Additional security	The tool provides three different authentication methods: answering on questions, access code authentication via SMS or knowledge-based authentication (point of time 2015 only American ID) (Haidary, 2015)
Legal aspects	The requirements of the eIDAS are fulfilled, for all types of ES described in the regulation. Moreover, Vasco supposed that the tool will be compliant to the GDPR until the 25th May 2018. The tool can be used in the most countries of the world. (Brazell, 2016; VASCO, 2018b)

Table C.8: Summary eSign Live

### C.5.8 PandaDoc

PandaDoc is tool, which was also a tool, which was mentioned by cc. It has more functionalities than only signing of documents. The test protocol is placed in appendix C.13 and the result is summarized along with other information from the internet in table C.9.

Criterion	Fulfillment
Integration	PandaDoc offers already integration for HubSpot and Google Drive, both used or available at cc (PandaDoc, Inc., 2018b). Additionally, an API exist, which can be used to create individual integration (PandaDoc, Inc., 2018a).
Device independent	The tool is online available and has Apps for Android and iOS, but the App for Android did not start in the test.
Usability	The basic functionalities are available, but not all like the company stamp. In general some drag-and-drop actions need to be taken to prepare the document for the signing. Additionally, some more functionalities exists like the document creation.

Costs	The cost will be around 74.400,00 \$ per year for 2400 documents and 80 users. Included is an access to the API and the web application, document creation, custom branding and other features. Once 1.500,00\$ could be paid to have an onboarding. The costs for one document are 19\$, which is translated 15,88 €based on the exchange rate from the 14th May 2018. C.15
Accepted file formats	In the test it was figured out that PDF and Microsoft Word is accepted along with images formats. Open Office is not accepted.
Operating mode	The provider offers the tool as SaaS application. (PandaDoc, Inc., 2017)
Additional security	Not presented and nothing for testing available.
Legal aspects	PandaDoc will fulfill the requirements of the GDPR and the fulfills already the standards from USA. It is explained, that there are three different types of ES is provided: insecure ES, secure ES and digital ES. (PandaDoc, Inc., 5/04/2018; PandaDoc, Inc., 2018c)

Table C.9: Summary PandaDoc

### C.5.9 eSignAnyWhere

To the provider of the tool eSignAnyWhere Namirial one employee of cc has connections. This is the reason why it is taken into account. It is also the only tool in the selection, which was developed by an EU company (NAMIRIAL SRL, 2017c). The information collected are summarized in table C.10 and test protocol is in the appendix C.14.

Criterion	Fulfillment
Integration	There is an API available with extended tutorials. Moreover, exists a Plugin for Microsoft Word. (NAMIRIAL SRL, 2017d; NAMIRIAL SRL, 2017a; NAMIRIAL SRL, 2017f)
Device independent	The system is device independent and offers Apps for iOS and Android. It is not clear, which one to use. (NAMIRIAL SRL, 2017g)
Usability	The tool is intuitive usable. On the web application a few manual steps need to be done, but there is the option to do it automatically with placeholders in a document, so that the tool knows where to place the different fields. But a company stamp is not available. (NAMIRIAL SRL, 2017f)
Costs	Based on the information received from the contact of the provider it will cost cc 3.000€ for 2500 documents per year with an infinite amount of users. The unused documents will be expired after a year. In the case that the volume is already consumed before the year ends, cc could order a new volume. The price for one document is 1,25 €. (Appendix C.19)
Accepted file formats	It is tested that the tool accepts PDF, Microsoft Word and some images files, but no Open Office files for a document. But for attachments more file formats are accepted, also Open Office files.
Operating mode	The tool is available as SaaS or as OP (NAMIRIAL SRL, 2017b).
Additional security	Multi-factor authentication is available in the tool. In general the authentication is a pin given by the initiator of the process or by the tool via a SMS or with Windows live. (NAMIRIAL SRL, 2017e)
Legal aspects	The tool offers different kinds of ES and is based on that allowed to be used in the EU and worldwide. Moreover, is the tool listed in the EU Trust List, where all trusted services regarding the eIDAS are listed. (NAMIRIAL SRL, 2017e; European Commission, 2018)

Table C.10: Summary eSignAnyWhere

## C.6 Comparison

This section will compare the result of the research. Therefore, a calculation of the costs ranges with the average and the limits, a summary is done and afterwards the comparison.

First of all the calculation for the costs criteria is done. The average is the sum of all prices for one document divided by the number of tools taken into account. In the case there is no price information given, the tool is ignored for the calculation. All number are rounded up to two decimals behind the comma.

$$\begin{aligned}\sum &= 15,88 + 4,93 + 7,92 + 7,63 + 1,25 + 0,83 = 38,44 \\ \varnothing &= \sum / \#tools = 38,44/6 = 6,41\end{aligned}$$

This leads to the following limits, given in table C.11:

Limit	-50%	-25%	Ø	+25%
Value	3,21	4,81	6,41	8,02

Table C.11: Limits value for cost comparison

Based on the criteria defined in section ?? and the calculation did above, the different tools are summarized with the regarding weight. That is done in Table C.12. In the case there is no information available a "/" is used to visualize it.

Criterion	Tool								
	Wacom	DocuSign	HelloSign	SignDoc	Adobe Sign	SignNow	eSign Live	PandaDoc	eSignAnyWhere
Integration	--	++	++	+	++	++	+	++	+
Device Independent	--	++	++	--	++	++	++	++	++
Usability	/	+	o	/	o	o	o	o	+
Costs	/	+	-	/	/	++	-	--	++
Accepted file formats	/	+	++	/	+	++	++	+	+
Operating mode	/	++	++	o	++	++	++	++	++
Additional security	/	++	+	/	++	+	+	--	++
Legal aspects	/	++	++	/	/	++	++	++	++

Table C.12: Summary of tools based on criteria

To make a better comparison of the different ES types, a translation from weighting to points is done in table C.13 which is used in a later calculation.

Weight	/	--	-	o	+	++
Points	-10	-2	-1	0	1	2

Table C.13: 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:

$$Sum = Importance\ of\ Criterion * Points\ of\ Weight$$

The result of that calculation is presented in table C.14. If a tool has more than one "/", it is ignored, due to the

Criterion	Tool					
	DocuSign	HelloSign	SignNow	eSign Live	PandaDoc	eSignAnyWhere
Integration	16	16	16	8	16	8
Device Independent	14	14	14	14	14	14
Usability	6	0	0	0	0	6
Costs	5	-5	10	-5	-10	10
Accepted file formats	4	8	8	8	4	4



Operating mode	6	6	6	6	6	6
Additional security	4	2	2	2	-8	4
Legal aspects	2	2	2	2	2	4
Total Sum	57	43	58	35	24	56

Table C.14: Comparison of tools

## C.7 Advice

Based on the defined criteria of the company the advice would be to use the tool SignNow, because it got the most points as can be seen in table C.14. But it is not clear if the usage of the web application is included. Moreover, was the contact with the tool provider only via mail and not any phone call or video conference was scheduled to clarify misunderstandings or unclear things, like concrete use cases.

Therefore, it would be advisable to choose the tool DocuSign, it fulfills all criteria and the most with full satisfaction. Furthermore, is a German-speaking support available and cc can choose where to store the data in the EU. It is the only tool that has the company stamp usage and has already some integration for the Google Suite. Additional a two-factor authentication for the signing process is available.

## **C.8 Test Protocol DocuSign**

Inside this part the testing of the tool DocuSign is documented. The tests are executed based on the definitions of research about Tools to Sign Documents Electronically. It is done at the third and fourth April 2018.

### **C.8.1 Registration**

The registration for testing the tool is simple. The following data need to be added:

- Name,
- Email,
- Job title,
- Company,
- Business area,
- Amount of employees,
- Phone number and
- A reason why it is used.

Later you need to select a password and confirm it. The testing duration will take 30th days. After that time the signed documents are still available, but a new starting of a signing process is not possible without payment. It also possible to sign free, but that is limited through the number of starting a signing process.

The normal login is simple, you only need to enter your mail and the selected password. That is the same for the App. In the case a person only needs sign a document, no registration is necessary. The person can access the document via a link every time.

### **C.8.2 Uploading Documents**

On the web version a button is available which opens by clicking a document chooser with the directory of the computer the web browser is opened. Through that the navigation is similar to other tools like Microsoft Word. Now the tester can navigate to the test document and select it. Then DocuSign offers the option to select additional files. It is also possible to add a document with the drag-and-drop functionality. Furthermore, a document could be chosen from templates stored at DocuSign. If the App is used a photo from the document could be made and this could then be used to sign.

In the case a document is selected and uploaded, several actions could be done with it: Show the document, rename it, compare it with a template, replace or delete the document. DocuSign accepts several document types like PDF or Microsoft Words ".docx".

### **C.8.3 Sharing of Documents**

The sharing is simple. Only the name and the mail address of the person need to sign is to enter. In the case the person was already requested to sign a document, the contact data is stored by DocuSign on the web version

and could be selected with the address book. The App uses the contact data from the smartphone. As a feature different roles could be selected:

1. A person which need to sign
2. A person which sign locally (only in the business version)
3. A person which receives an information

Moreover, there is the option to add a security level. This is done by requesting an access code defined by adding the person to sign. In the case the person now want to sign, he/she need to enter before the code. This code need to be transmitted somehow to this person. Furthermore, it is feasible to remove a person from the list of sharing.

#### **C.8.4 Select Order of Signing**

Within the web application it is possible to select an order for the signing, with the test in the App it was not possible. It is simple, either do it with drag-and-drop or enter the number before the contact box. Also, the user can select if an order is necessary or if two or more person need to sign first ante the other persons.

#### **C.8.5 Preparation for Signing**

In this action all required fields need to be manual placed in the document. This is quite easy and there are a lot of fields type by default, which can be customized in the business version of the tool. The fields are for example signature, name, mail or date of signing. Also, it is possible to twist the document if it is necessary. Furthermore, there is the option that on each document file uploaded to sign could be prepared separate.

#### **C.8.6 Company Stamp**

The tool allows the using of stamps. Therefore, this option need to be activated in the settings. When this action is done, a new field type is available by the preparation for the signing action.

In the case the stamp is the first time requested, a window is open with the request to upload a picture of the stamp. This picture can be fit and gets a name. Also, there is the option to declare the created stamp as default stamp.

#### **C.8.7 Signing Documents**

Within the step of signing a document several options are possible, each of them is described below.

##### **One Person**

Regarding the fact that not always more than one person need to sign, two options exist. First the person who start the process need to sign or second another person need to sign. Both cases are similar and are basically the same as multiple person would sign the document. The only difference is that int he first option the user will be redirected after the preparation to the signing action. In the other case the user receives a mail.

## Multiple Persons

All persons get an invitation via mail to sign the document. If there is a specified order, they receive the mail not until the person(s) need to sign previous have signed it successfully. When all persons have signed the document, all of them will receive a mail with the link to the completed document.

## Unregistered Person

If the person need to sign the document is not registered at DocuSign, he gets a mail and can access the document via a button or link. Then the person need to agree the usage of an ES or can select other options like decline or alternatives explained in the features. Next the requested fields need to be filled in. In the case of the signature filed, the person can correct the name and the initials and is allowed to choose between selecting a signature style or drawing the signature with the mouse. Finally, if all required fields are filled in, the signing process could be finished, a windows pop ups with the option to register at DocuSign and a mail is sent to all parties when the document is completely signed.

## Decline Signing

All persons, who not started the signing process, have the right to decline the signing. Then the complete order of signing is stopped and all parties get a mail with the information about the declining. The person has the option to enter a reason, which is also submitted with the mail.

## Features

The tool provides several features not requested in the test setup, but are still tested. They will be explained beneath.

**Signing in a Local Session** When the mail is received with the link of the to be signed document and the button is clicked to access it, first an information page about the process is shown. When the start button is clicked, the users are leaded through the process. The person, who need to signed, accept the using of the ES and can then fill in the fields. In the case of the signature filed, the person can correct the name and the initials and is allowed to choose between selecting a signature style or drawing the signature with the mouse. Finally, if all required fields are filled in, the signing process could be finished, a mail address is requested to send a copy of complete signed document.

**Print and Sign** Sometimes a person or company accepts the ES, but want to sign with the handwritten signature. Therefore, this option exists at DocuSign. The person which had to sign can print the document, sign it with all required fields manual and either upload it again to DocuSign or send with fax back.

The uploading process is simple, just download the document, print and sign it, scan it and finally upload it again. The only disadvantage which is inside this process, is that the person need to sign either should not close the option and do the previous described process directly or need to start the process again.

In the case the fax option is used the document need to be downloaded. This document is different then the standard document, because it has an additional page containing all information required to fax it back to the tool.

**Assign to Someone Else** Regarding the fact, that not every time the correct person is assigned to sign a document, DocuSign offers the option to redirect this task, by the person which receive the invitation of signing. This person can refer the document to a different person by adding their name and mail address and gets a copy of the signed document. The other person receives a request to sign the document as described above. Every time the document owner, who started the signing process, is informed about such changes. It is possible to deny such action by setting a permission at the step where the process is started.

**Reverse Signing Process** In the case a document is not completely signed, there is the option for the person who started the signing process to stop the process. The document is then voided. All parties involved in the stopped process get an information that the document is voided.

**Reports** A feature of DocuSign is that it creates statistics and reports about the usage of the tool. This means it presents statistics about the amount of documents to be signed or their status. There are more options available, here is only a short overview given.

### C.8.8 Status Report

Within DocuSign it is possible to track the status of a document. Several information exist like at which time some received, looked and signed the document. In this functionality other actions could be triggered like sending the document again, make changes to it or download the current document.

Furthermore, there are the options for those users which have a DocuSign account to see "open" documents, that are assigned to be signed by them. This view also available in the App.

### C.8.9 Availability of Documents

After the signing process is completed all persons related to the document receives a notification, that contains a link to the document. Furthermore, the document is stored at DocuSign and can be accessed with the login data of the accounts. Inside the tool they are sorted by different categories e.g. if the person send the document or if the document is completed. The document always can be downloaded or printed in the online document view. This functionality is available with the link send from DocuSign or by accessing from the tool itself.

### C.8.10 Personal Impression

The handling of the tool DocuSign is simple. It has a lot of options to sign documents, even in the case one of the involved parties is not allowed to sign electronically, do not want to create an account or pay for it. Also, there are a few nice features available, which at the moment are not requested by cc. Moreover, the look and feel is user-friendly. Another big advantage of DocuSign is the App, which cost nothing. It has the most functionalities as the web application and makes the handling of signing process mobile.

## C.9 Test Protocol HelloSign

This document is a testing protocol created at the 9th April 2018. The tool HelloSign is tested based on the test scenario described in the research about Tools to Sign Documents Electronically.

### **C.9.1 Registration**

HelloSign offers different plans with several extending functionalities. For the registration of a none free version, the credit card number is requested, due to the fact that the versions runs until it will be terminated. For the testing the free version is used, but this is limited to documents and functionalities. The other test versions would be available for 30th days for free and would be automatically transferred to a paid version after these days.

To get the free version some information are requested:

- Name,
- Position,
- Department,
- Company name,
- Business area and
- A reason why it is used.

In the case another version is used, the credit card information need to be given.

The registration in general is simple. First you need to add your mail address, verify it and then select a password.

### **C.9.2 Uploading Documents**

To upload a document several options exist. You can select a file within the document chooser, use a template stored at HelloSign, drag the file in the browser or import the document from a service like Dropbox or Google Drive.

Within the tool the tested document formats PDF, Microsoft Word and Open Office Writer was accepted without errors. Moreover, it was possible to selected different formats for one signing process.

### **C.9.3 Sharing of Documents**

To add person, who had to sign the documents is simple. Just add the name of them and insert the mail address in the required fields. At the beginning the process initiator select which parties had to sign. He can choose between those three options: me, me & others and others. Before the invitation for signing is sent the subject and the body of the mail could be defined.

### **C.9.4 Select Order of Signing**

Also, the selecting of an order for signing is simple. Just activate it with a checkbox and then move the different signing parties in the correct order. The only disadvantage is that multiple parties can not sign at the same order level.

### **C.9.5 Preparation for Signing**

Inside the documents the fields for signing are added manually by drag and drop. The field could be from the following types: signature, initials, textbox, checkbox and sign date. In the case multiple parties need to sign the document, the initiator need to define which field belongs to which party. If the initiator need also to sign the document, he can it do directly after the setting the corresponding fields.

### **C.9.6 Company Stamp**

This functionality is not testable, because therefore at least the business plan is required, which is not available for testing.

### **C.9.7 Signing Documents**

In the case there exist no saved signature, several options exist to generate one:

1. Draw a signature: Within this option the mouse is used to draw the signature.
2. Type a signature: The user types its name in the field and the tool generates the signature. In the next step the user can select the style of the signature.
3. Upload an image of a signature: select image, adjust it
4. Use a smartphone: make picture of signature, mail it to specific mail with certain subject, go ahead as previous step

After adding the signature to the document, the signer need to agree that he accepts the usage of ES.

#### **One Person**

The signing of a document is fast. The user receives a mail or is directly by setting up the file requested to sign the document. In the mail a button need to click to open the document. Then the fields need to filled in with the requested data. In the case of a signature either the actions described above need to be performed or if the user signed already the stored signature could be used. It is also similar for the initials.

#### **Multiple Persons**

Every single person sign the document as described in the part for one person. The only different is, that they receive status information about the actions from the other persons. Moreover, it is not possible to sign against the order, the person, who has to sign later, receives a mail that he has to sign at a certain time and will receive another mail when it is possible.

#### **Unregistered Person**

The signing process for an unregistered person is also as described in the part above for one person. He receives an invitation to sign the document, enter the data required, select a signature and agree the usage of ES. Finally, he receives the question if he wants to activate a free account, which could be ignored.

## **Decline Signing**

Every party has the option to decline the signing. Therefore, the action need to be selected from the available options of the document. The person is asked to give reason and send the information.

## **Features**

In higher versions of HelloSign than the free version some features, like branding or changing of settings are available, which are not tested during the circumstances of using the test versions.

Moreover, HelloSign provides an App for Android and iOS, which is available for free. It provides the functionality to start a signing process. Therefore, the documents can be scanned in as picture or imported from the device the App is running on. But it is not possible to sign a document that is assigned to the user of the App, if it is not in the initiation process. Also, it is not possible to see that status of document.

### **C.9.8 Status Report**

Inside the web application the user can see the status of a document, if he has an HelloSign account. The status is presented through colors and descriptions. There exists also the functionality to see the status of the document by all parties assigned to the process with a mail report.

### **C.9.9 Availability of Document**

HelloSign offers for user the option to handle documents. They could be deleted, shared, edited or downloaded from the web application. But all persons assigned to the process receives after completion a mail with the signed document attached.

### **C.9.10 Personal Impression**

In general need to be said, that HelloSign may be useful, but the need to give payment data to test the tool in a higher version and the not ideal App leads to an unsatisfied feeling by using it. The general handling is simple and intuitive, within the functionalities could be tested during the test.

## **C.10 Test Protocol Adobe Sign**

The tool Adobe Sign, which is selected for the research Tool to Sign Electronically, is tested at the 11th April 2018 with the test version of a duration from fifteen days. The test criteria are described in the research. Inside the test also the App is included. It is available for iOS and Android, but due to the fact that only an Android smartphone is available, the test will be on that OS.

### **C.10.1 Registration**

To register at the tool for testing several data is required like name, mail address, phone number, company, position and birth date. Moreover, an AdobeID is generated if the new user does not have it already. Afterwards



the user need to approve the mail address, set a password and can use the tool. The login is later standard. Just enter the mail address and the password.

### **C.10.2 Uploading Documents**

The web application has two options to upload a document for signing. The first one is a drag and drop function, which is explained in short words at the moment a document should be uploaded. The other option is the file chooser. This is a link that opens a window, where the user can select from which source (computer, stored in the tool or from another cloud storage) and directory a document should be imported.

### **C.10.3 Sharing of Documents**

To add other people to sign a document only the name of the persons and their mail address need to be added. Moreover, it is possible to add a subject and a message inside the mail, that will be sent to all people.

### **C.10.4 Select Order of Signing**

Adobe Sign offers the opportunity sign documents in a defined sequence. Therefore, this option need to be enabled by setting the requirements for the documents. Afterwards the order could be changed with a drag and drop functionality or add the position number manual.

### **C.10.5 Preparation for Signing**

To prepare a document for the signing, only a few manual actions need to be done. The required fields need to be added to the document with a drag and drop functionality. In the case that multiple persons need to sign the document the initiator opens with a click on the added field a drop down menu with all persons inside and select the one who had to fill in this field.

Adobe Sign offers different field types. Here are some examples: signature, initials, signature block (signature, date and mail address), stamp, name of the person and the company. It is also possible in the enterprise version to customize the fields or create new one.

### **C.10.6 Company Stamp**

The tool has the option of the usage from stamps. Therefore, the specific field type need to be added to the document as described previously. In the step of filling the data, the signer has two options to insert the stamp. The one option is to upload a picture from the computer and fit it with the size. The other option is to use the smartphone. The actions need to be done are the following: enter phone number, click the received link, make with it a photo of the stamp or select a photo from the phone, send the picture back to the tool and fit the size.

### **C.10.7 Signing Documents**

Every person requested to sign a document receives a mail. Only about the link placed in the mail it is possible to sign the documents. By default, the following four options are usable to create a signature:

1. Typing: The person types its name in the declared field and the tool generates from that a signature.

2. Drawing: The person draws with his mouse or with the touch pad his signature.
3. Upload image: An image of the signature can be uploaded from the computer or a cloud storage.
4. Use the mobile phone: This option is similar to the company stamp. The user enters his phone number and receives a link. By opening this link the user has two options. Either he draws the signature on the smartphone or he uploads/makes an image of the signature.

But it is possible to change that in the settings of the account. After filling all the required data, the person need to agree on the usage of the electronically way, but also this is changeable in the settings.

### **One Person**

It is possible that only one person a sign a document, but there is one requirement: It is not the initiator of the signing process. But in general the process is open the link in the received mail, fill in all required fields and generate a signature or select the existing one (if the user has already an account). Finally, he need to agree.

### **Multiple Persons**

If multiple persons need to sign a document, it is not possible to sign it if someone else does it at the same moment. If there is an order, it is not possible to sign against it. The later signer receives the link just if the previous have signed. But the process is the same for everyone as described in the part for one person.

### **Unregistered Person**

For the unregistered person it is the same as described above, the only differences are that he can not select a stored signature and can download the document from the tool. He will receive it with a mail when the document is completely signed.

### **Decline Signing**

Adobe Sign offers the persons who had to sign the option to deny the signature. Therefore, the person had to select this option at the upper left corner of the view and type a reason to finalize the step.

### **Features**

The tool offers two functionalities not requested in the test scenario. They will be explained below.

**Assign someone else to sign** Other users than the initiator have the option to delegate the signing. Therefore, they could select the option in the upper left corner of the document view and enter the name and mail address of the other person and a message and its done. All persons inside the process (also those who delegated it) will receive a mail with the finished document.

**Security aspects** To sign a document the initiator can request for access data to sign. That can be a password, an online-identity(Google Account, LinkedIn or Xing) or a knowledge-based authentication(Personal data with later questions). But this is only in the first instance possible. In the case the signing is delegated, the new person do not receive the security request. Moreover, if the security aspect is assigned to the initiator and he signs directly, no request is done.

### **C.10.8 Status Report**

All person involved in the process of signing receives per default the status reports via mail if someone signed or declined the document. The initiator and all persons having an account could see the status also in the tool or the App.

### **C.10.9 Availability of Document**

The completed documents are sent with a mail. In the case the user has an account for the tool, he can see them also on the web application and the App. It is also possible to share the complete document from the web application.

### **C.10.10 Personal Impression**

In general the tool is intuitive and easy to use, also the App. The only aspects, which are to be criticized are, that a user can not sign the document from the tool and the look of the tool could be nicer.

## **C.11 Test Protocol SignNow**

This tool is tested based on the requirements defined in the research about tools to sign documents electronically. It is done at the twelfth April 2018 with the test version of the Business Premium plan, which has a duration of six days. Additionally, an App exist, which is tested on an Android system.

### **C.11.1 Registration**

To register in the test version only the following data is required: name, mail address and password. After submit that data to the tool a mail verification is done and the user can sign in.

### **C.11.2 Uploading Documents**

On the web application of SignNow only a file chooser exists, in which the user can select the document from a directory at the computer. In the case he often need to sign/ let sign a document, he could make a template out of it, which is stored at SignNow. Inside the App more options exist to select a document: make a picture from it, import it from another App running on the smartphone/tablet or upload it from the SD-card.

### **C.11.3 Sharing of Documents**

Another important aspect is the sharing of the documents for signing or notification. Within SignNow it is simple: Just add the name and the mail address of those persons who should sign the document or notified about it. This could also be done when the document is completely signed and need to be shared again without signing. Moreover, it is possible to customize the subject text content of the mail per user. In the App it is not possible to share the document.

### **C.11.4 Select Order of Signing**

SignNow has the option to make an order of signing. It is called steps. A nice feature here is that multiple signer are allowed in one step. The order of the steps and the signers could be changed with a drag and drop functionality.

### **C.11.5 Preparation for Signing**

To prepare the document for signing a drag and drop functionality exists. The required fields could be selected per signer. In the case one or more signer are not associated to at least one field, the document could not be stored and an information window appears for that error.

There are several file types. There are two categories: The first can be used always, that means inside templates, free signing or for the initiator of a signing process. The second ones are only available when a new document is uploaded and could only assigned to those signer which are invited with a mail. These are they all:

1. Signature, date of signing, text and check box
2. Initials, request for attachments (additional documents/pictures), drop down menu to select one option or radio button to vote one of different options.

### **C.11.6 Company Stamp**

SignNow do not offer an option to add a company stamp. The field type request for attachments could be reused for that, but this is not a perfect solution through the fact, that it will not be integrated inside the document, but in a compromised directory.

### **C.11.7 Signing Documents**

The signing is simple inside SignNow. Only click on the filed for the signature and four options appears in a window:

1. Type: The user type his name in the defined field and the tool generates several styles based on the name. Afterwards the user select one of the style as his signature.
2. Drawing: The user draws the signature with the mouse or the touch pad.
3. Upload: The user uploads an image of his signature from a storage.

4. My signature: In the case the user had already signed with SignNow, the used signature from that is stored and can be reused.

In the App only the last three options are available. In the complete process the signers do not need to agree on accepting the ES by default.

The process initiator can directly sign within the step of the document preparation, all other receives a mail or get it shown in their view if they have an account.

### **One Person**

In the case only one person need to sign, it depends on how had to sign. If the initiator is the person, he directly can sign with opening the document, add the fields and store it. Afterwards he could share the document via mail. Else just the mail address need to be added, options and fields set and then it need to be sent. The signer click on the link or select it in the view of the tool if he has an account, fill in the data and click on done. In the step of filling the data fields he is guided. The signing is also possible within the App.

### **Multiple Persons**

In the case of multiple signatures are required, the tool controls that all receives the invitation of signing, that there are no multiple signatures are at the same time and that are all signed based on the order if set. The process of signing is for each person the same as described in the part for one person above.

### **Unregistered Person**

It is also possible to sign a document even the person does not have an account. He can generate a signature as described above. In the case he already signed a document with SignNow, the tool stored his signature.

### **Decline Signing**

A person, who is asked to sign a document, can also decline this request due to select the option by viewing the document. After the selection he can enter a reason and this information will sent to all involved parties. In the case he later changes his opinion he can sign it then, if the document is not deleted by the owner.

### **Features**

SignNow offers some functionalities not requested in the test scenario, which are tested as well. They are described below.

**Delegate signing** In the case the initiator do not enable the option it is possible to forward the document to someone else to sign. Therefore, only the name and the mail address need to be entered. If this option is not disabled, no security level could be added.

**Free signing** Another feature is to send a document for signing to some other, but do not set any field to be filled by others. The other party can decide which fields to set where. The only requirement is a signature field. After the document is signed by all parties, all receives the completed document.

**Signing link** This feature is similar to the free signing. The differences are the following: First it is only for templates (stored documents that are defined as templates and often used) and a link is generated, which can be sent to all persons that should sign the template.

**Security aspects** The tool offers three different security methods. Only one of them could be tested through the fact that the others are only available for user with an American phone number.

1. Password: To sign a document a password need to be entered before. Therefore, it will be added per mail address in the preparation of the sending. It need to be submitted to those persons in some way.
2. SMS: This option was not testable. The initiator need to enter a phone number and the other person receives an SMS with a password, which need to be entered before signing.
3. Phone call: This option was not testable and no description was found.

### **C.11.8 Status Report**

In the case the user has an account he can see the status within the web application or in the App, if he installed on the smartphone/tablet. Otherwise it is possible to set the option to receive status information with mails. This is than possible for all person assigned to the document.

### **C.11.9 Availability of Document**

After the signing the document is available for all persons, involved in the signing process, having an account at SignNow on the web application or the App. Moreover, all people receive a mail with the complete signed document and in the case files were attached also them.

### **C.11.10 Personal Impression**

The tool looks different in the browsers. In Firefox, they look better and gives more guidance, than in Google Chrome or Internet Explorer. But generally the tool is most of the time intuitive and a user manual is online available.

## **C.12 Test Protocol eSign live**

The tool is tested based on the scenario described in the research tools to sign documents electronically. It is done at the 16th April 2018. Furthermore, the App for Android is tested.

### **C.12.1 Registration**

To register for the test version the user need to enter the following data: name, mail, password, company name, company are, phone number and country. In the case a person is already registered he can log in with the mail and the password.

### **C.12.2 Uploading Documents**

The systems (App and web) allow different document usage:

- Web application:
  1. Template: Inside the tool the user can create templates for standard documents like Non-Disclosures Agreement. They could be used as much the user want.
  2. Finished document from computer: Therefore, the user clicks on a button and a file chooser pops up, where the user navigates to the storage of the document file and select it.
- App:
  1. Choose an existing document file from device: Therefore, the user clicks on a button and a file chooser pops up, where the user navigates to the storage of the document file and select it.
  2. Select from another App: The user can select documents file stored in another storage App. Inside this the user can navigate as given from the App.
  3. Make an image of the document: The App offers the option to make a photo from the document need to sign.
  4. Template: Inside the tool the user can create templates for standard documents like Non-Disclosures Agreement. They could be used as much the user want.

### **C.12.3 Sharing of Documents**

To share a document for signing, notification or forwarding just the mail address and the name of the persons should receive the document need to be entered.

### **C.12.4 Select Order of Signing**

In the case there should be an order to sign, this option need to be enabled within the view to add signers and persons that need to be notified. Afterwards, the user can set the order either by adding them based on the order or by drag and drop the different parties.

### **C.12.5 Preparation for Signing**

Before a document could be sent to sign, the required fields need to be set via a drag and drop functionality. The fields can be chosen per person who had to fill the field or can be selected in the option of the field. Additionally, each field beside the signature field can be set either as required or as not required.

The following field types are available at eSign Live: signature, initials, date, name, title, company, text field, text area, check box, radio, list and label field.

### **C.12.6 Company Stamp**

The tool does not provide the possibility to add a company stamp directly. It can be done with the attachment of documents, where the description explains that a company stamp is required and set this to required.

## C.12.7 Signing Documents

eSign Live offers two options to sign a document:

- Click-to-sign: The signer clicks on a button and confirm the agreement to accept this as a signature.
- Capture signature: The signer draw his signature with the mouse or other device in the area given from the tool to draw. Afterwards, he confirms that he accepts this as signature.

### One Person

In the case the person has an account he will be notified by the tool on the web application or the App and with a mail. In the case he goes with the mail, the user clicks on a link and will be forwarded to the document. Otherwise, he can access the document directly by clicking on it. First of all he need to accept the disclosures, this step is not done if the signer is equal to the initiator of the signing process. Next the user clicks on the fields that need to be filled manual, if they are not required he is not indebted to fill them. Afterwards, he generates the signature as described above and finish the signing process for him.

### Multiple Persons

For each person it is equal to one person. There are two more aspects, that need to mentioned here. The first one is that the signers will be notified to be signed after the previous signer has signed if there exists an order for the signing. The second aspects is that the document can only accessed by one person per time. That means if two persons want to sign the document at the same time, it is not possible, because the tool will one of them deny the access until the other has closed the document or finished his signing process.

### Unregistered Person

In the case the signer is not registered at eSign Live he will only receive a mail with a link. By clicking this link the signer will be redirected to the document and can sign as described for one person.

### Decline Signing

The declining of the signature is not offered by eSign Live. It could only be done by do not signing the document and in the case there is end data for signing it will be marked as not agreed.

### Features

eSign Live offers more actions than requested in the test scenario. They will be described below.

**In-person signing** The tool offers the possibility to let sign the signers on the device of the initiator of the process. This option need to be set by the preparation process for sharing the document. Once the finalization of the document preparation the initiator receives a link to let the other person(s) sign. There is a delegation through the signing process. Afterwards, the signer receives a mail with the signed document.



**Review before completion** Another feature is the option to review a document after all signers signed it. With this option the users have the possibility to check if everything is inserted correctly or proof that another person notified the completed document.

**Authentication** There are several options to prove the authenticity of the signers:

- **SMS with PIN code:** The initiator and the signer need to type a phone number and to this number a SMS is sent with an access code. Only when the access code is typed correctly in, the signer has access to the document.
- **Question and Answers:** The initiator selects one to two questions with answers and needs to inform the signer about the answers. The signer can only sign the document if he can answer the questions. The answers need to be equal to the typed one of the initiator.
- **Knowledge-Based Authentication:** This authentication method is only available in USA and Canada. The signer needs to answer questions based on a personal credit report.

**Attachments** Moreover, it is possible to add additional files to the document by the signer. Therefore, the option needs to be set in the preparation. To activate this option the name and the description of the attachment is required, so that the signers know what to enter. Every attachment is assigned to one signer.

**Disclosures** eSign Live offers the feature to customize the disclosures. Inside additional legal aspects could be mentioned. This disclosure needs to be agreed from the signer before he can sign the document. It is possible to set it at the end of the signing process.

**Accept only** Another feature is the option to let the document be accepted by another person. This is different to the signing. The user needs to click on a button at the end of the document and there will be no signature done.

**Delegate signing** The last feature is the delegation of the signature. This needs to be enabled per signer. In the case the person, who is assigned to sign, is not allowed to sign, he can delegate it to another person. Therefore, he needs to click on a button on the top of the document view, which is not good visible (The button does not appear when the option is disabled.) Then the name and the mail of the new signer need to be inserted and if wanted additional authentication methods. Finally, the new signer receives an invitation to sign and the old signer will be added to the list of the persons, which receives the completed document as notification.

### C.12.8 Status Report

eSign Live presents the status of documents at several places. In the start view of the web application and App a general summary is given. A detailed report is presented in a separate view, where the documents could be sorted based on the status or the time they were created.

### C.12.9 Availability of Document

For users with and without an account the completed documents are available via a link that they receive with a mail or download them after they signed it. The persons having an account do have the possibility to reach

them about the web application or the App about the document view, where also the status is presented.

### **C.12.10 Personal Impression**

The tool offers the most functionalities requested from cc. Missing is the company stamp and the declining of signing. It is really comfortable that the web application and the App looks very similar and can be used without many differences.

## **C.13 Test Protocol PandaDoc**

This is the test protocol for the tool PandaDoc. Tested is the business plan, which is free for fourteen days. The date of the test is the 18th April 2018. For PandaDoc an App is available, but it always crashes by starting it on Android. Therefore, it is not tested. In general need to be said, that the tool has more functionalities than only signing of documents. It is also possible to create documents with it.

### **C.13.1 Registration**

The registration is simple for the test version. Just enter the name, mail and a password. The next step is to add the job level and role of the tester, the company and the phone number. Finally, a mail verification is done.

### **C.13.2 Uploading Documents**

There are three possibilities to select a document for signing. The first one is to create the document directly in PandaDoc with predefined text blocks and fields that need to be filled with content. The second option is the choosing of a template, either an own or a global one, where only a few texts and data aspects need to be fitted to the current purpose. The last choice could be the uploading of a document from the computer, phone or Google Drive account. Therefore, a document chooser is opened and the user can navigate to place where the document to be signed is placed.

### **C.13.3 Sharing of Documents**

To share a document for signing is simple. The initiator of the process needs to know the name and the mail address of the other persons, add them to sign and it is done. The assigned persons receive a mail where they can access the document.

### **C.13.4 Select Order of Signing**

PandaDoc offers the option to set up a signing order. Therefore, the user needs to enable the option and has several possibilities: He enters the signer in the order he wants (in the case there was no one added before), accepts the order from the entering or drag and drop the order in the view for the ordering.

### **C.13.5 Preparation for Signing**

The preparation for the signing is less manual work, which is not always intuitive. The fields are positioned with a drag and drop functionality in the document representation. Then the user needs to decide if the field is required and who has to fill it with data of the signer.

The field types are: signature (to sign), initials (representing the initials of the name from the signer), date of signing, checkbox (if agreed to a point), drop-down menu to select one from given options, a masked field to fill in hidden information, an upload field for adding attachments like images and finally a text field is available, where the signer can enter a free text.

### **C.13.6 Company Stamp**

In PandaDoc there is no field for a company stamp provided. In the case it is really required, the upload field could be used, but this is not a perfect solution, because there is no image representation in the document after adding the image of the stamp to it.

### **C.13.7 Signing Documents**

To sign a document first a signature needs to be created. Therefore, there exist three options if they are not disabled by the signer. They are:

1. Draw: The signer draws with the mouse or the finger on the touchpad/display the signature and accepts it as his electronic signature.
2. Type: The signer types his name (only in the case the field is not already filled and it is incorrect), selects a writing style and color and finally accepts the signature as his electronic signature.
3. Upload: The signer uploads a picture of his signature or any other image (it is not checked) and accepts this as his electronic signature.

All fields marked by the initiator as required need to be filled, but the tool leads the signer through this process.

#### **One Person**

The only difference in one person signing is when the only signer is the initiator of the signing. He can directly fill in the required fields at and after the creation in the tool. Additionally, he receives a mail with the request to sign. In the case he does not have a signature already, he can create one described above.

For other users it is a bit different. They receive an invitation to sign within a mail, where they can click on the button or link. Then the document will be opened, and they can enter the requested data and create a signature. If they have an account at PandaDoc already they can access the document also from the tool, but only in the case the request is associated to the same mail as they are registered in PandaDoc.

#### **Multiple Persons**

If multiple persons need to sign a document, they can do it as described for each person. The only exception is that they can not do it in parallel. They also receive the mail with the invitation at the same time. This only

in the case difference, when an order is declared. Then they receive the invitation soonest if the person before them have signed the document.

### **Unregistered Person**

An person, which is not registered at PandaDoc do not need to create an account to sign documents. He only generates each time a new signature and accepts it. For him is the document always available about a link, send after the document is completely signed.

### **Decline Signing**

PandaDoc does not offer the decline of signing direct. The only possibility is to wait until the deadline of the signing is expired.

### **Features**

The tool offers different additional features, which are not requested by the test scenario.

**Document Forwarding** One simple feature is that the process initiator can enable the option for one or multiple signer to share the document. In the document presentation for the persons having this option an additional button is added. By clicking this button the user can enter the mail address and name of the person(s) ha want to share the document. When the document is completely signed, the person(s) receive also a mail with the link to the final document presentation.

**Signature Forwarding** Another feature is the possibility to delegate the signature. But therefore, the previous explained feature need to be enabled and the signature forwarding need to be enabled in the same view. The user, using this possibility, makes the same as the feature above and enables in the same view the right the sign for him. The new invited person receives a mail with the request to sign the document.

**Branding** PandaDoc offers the option in the business plan to add the company layout to the mails, instead of it from the tool. Therefore, some changes in the settings need to be done.

**Creation of Documents** Moreover, the functionality exists to create documents. This done via drag-and-drop from layout components like header, text boxes or lists. They could be filled with the typing the content or choosing from stored data (for example from the product catalog).

**Contact Management** The tool offers the service of a contact management. All contacts required for the signing could be added, edit or removed. For each contact the name and mail is required. Additional information could be the company name. It is available, because PandaDoc could be migrated with tools for costumer relation management.

**Product Catalog** Inside the tool a functionality exists to work with a product catalog of the company. All products of the company can be maintained. That comes with the relation to the customer relation management.

### **C.13.8 Status Report**

To see the status of a document the user has three options:

1. Dashboard: In the start view a summary of all documents based on their status is presented. Moreover, the last created/added documents are displayed.
2. Document view: In this view all documents are visualized with a color based on their status. The user also can see/sort the documents based on status and name. Furthermore, the information is displayed, which user did what.
3. Mail notification: Inside the settings the user can set mail notifications for each action and status of the document, he will receive every time a mail when something changed.

### **C.13.9 Availability of Document**

After the document is completed, it is accessible via different ways:

- Application: Only users with an account at PandaDoc have the option to access the document about the tool. Therefore, they only need to go to a view where the documents are displayed.
- Link & Mail: All persons, linked to the document to sign or get notifications about the document, receive a mail with a link to it, but only in the case it is completed. Via the link it can be accessed as long it is not deleted from the system.

### **C.13.10 Personal Impression**

PandaDoc offers the basic functionalities required from cc and more, but it is not always intuitive to work with it. It is often difficult to keep the overview due all the functionalities. The problem is that for further development of the process of the contract management system the creation of documents will be part, because the tool offers already this part.

## **C.14 Test Protocol eSignAnyWhere**

The system eSignAnyWhere is tested at the 23rd April 2018. The test is defined in the research "Tools to Sign Documents Electronically" and the result is presented in this protocol. For the tool several Apps are available, but the testing was not possible due to the fact there is an unclear handling behind.

### **C.14.1 Registration**

The registration for the trail is done fast. The user need to add some information and can test the tool for 30th days. The information required are: name of the user, country, language, time zone the user works general, mail address and a password, which need to be confirmed. If they are entered, the user need to verify the mail. In general the login is done with the mail address and the password selected.

### C.14.2 Uploading Documents

eSignAnyWhere offers several options to add documents for signing:

- **Template:** In the tool the user has the options to create templates. Those could be used for starting a signing process.
- **Upload from local computer:** Another option is the uploading of a document from the local computer. A window pops up with a file chooser, where the user can delegate to the storage of the document.
- **Upload from another SaaS tool:** Furthermore, the option exist to upload documents from other online storage. Reachable from the tool are Dropbox, Google Drive, OneDrive and Box.

Additional there is the opportunity to rename the document after uploading it to the tool. In the case the file format is not PDF, the file, which represents the document, is converted to PDF. The tool do not support Open Office Formats, but several images formats and Microsoft formats.

### C.14.3 Sharing of Documents

To invite other persons to sign a document or add them to receive a copy of the completed file, the user only need their name and the mail address of them. This information will be added to the declared fields and then their task need to be defined. The tasks are the following: Needs to sign, needs to confirm and gets a copy.

### C.14.4 Select Order of Signing

Within the sharing step it is possible to define an order of who had to sign when. Therefore, it is important to mention, that the user can be ordered in steps. This means, multiple persons can sign in one order step, e.g. there are three persons, who had to sign, A, B and C. A and B work in the same company and both need to sign the document, before it is available for C, but it is not necessary that A needs to sign before B or vice versa. In this situation the initiator can add A and B in one signing step and C into step behind. This could be done by typing the order position in or drag and drop the signers in the position.

### C.14.5 Preparation for Signing

To prepare a document for signing, the user need to set the fields manual to the place he wants to have it. This can be done per person need to sign or the association is set after placing the field. Another thing that can be done is the declaration of settings, for example is the field required, adding a description or what types of signature is allowed.

The fields types are separated in the categories need-to-be-filled-by-person and will-be-filled-by-tool. To the first category belongs the fields: text, signature, radio button, check box, list, combo box and attachments. In the second category are mail, initials, fore-, sure- and complete name and date.

### C.14.6 Company Stamp

A company stamp is not available in the tool. In the case it is really required, it could be an option to choose the attachment field.

### **C.14.7 Signing Documents**

eSignAnyWhere allows several electronic signature types. These are they:

- **Confirm signature:** The person need to click on the signature field, the tool fills information like name, date and mail in and the person accept this as signature.
- **Draw signature:** The person draw the signature with the mouse, the touchpad or any other device that could capture the signature and this will be added to the document.
- **Type name:** The signer types his name in the declared field and the tool generates the signature out of it. Afterwards the person can select the style of the signature and the size of it.
- **Local certificate:** Upload a certificate for signing.
- **Digital distance signature:** Usage of a remote certificate to sign.

#### **One Person**

All persons need to sign will receive a mail with the request to sign the document. In the case the person has already an account, it will be also mentioned to him in the tool. In both cases the user click on the button to get the document to sign. In the case there is a deceleration of consent, he need to accept this and can fill in the associated fields. Then he can create a signature as described above or, if he has an account, use the stored signature. When all required fields are filled in, the signer finalize the signing by clicking a button. Finally, a window is opened, where the person can download the current version of the document with or without the audit trail, a file where all actions regarding the documents are documented.

#### **Multiple Persons**

In the case multiple persons are assigned to sign a document, they all receive a mail or notification based on the order defined. It is not possible, that two or more person can access the document at the same time. The signing process is for each person the same as for one person. But it need to be said, that the notification is not always good synchronized and during the test it happened that the test clients do not receive any mail and need to be remained.

#### **Unregistered Person**

For an unregistered person it is as simple as for a person with account to sign documents. They receive a link to the documents and can sign as explained above.

#### **Decline Signing**

It is possible to allow the other involved signer to decline the signature. Therefore, this option need to be enabled in the settings of the process creator. Before the signer can sign the document a window appears where he can select to decline the signature. Next he need to give a reason why he declined the contract and all people involved receives the information of the declining.

## Features

The tool offers some features not requested by the test scenario. They will be explained below.

**Delegation of Signing** It is possible for the signer to delegate the signing. It is possible to do it in the same window as in declining the signature. The person, using this option, need to add the name and the mail address of the new signer and he will be added to receive a copy.

**Contact Management** Inside eSignAnyWhere the contacts are store, which already received at least one invitation for signing. The user can add new contacts, edit existing or delete them.

**Deceleration of Consent** The user can define an own deceleration of consent. This need to be done in the settings. It need to be agreed every time a person signs a document created by the person with these settings.

**Security** The developer of the tool implemented some additional security levels. The initiator can set them by adding the signers. The verification will be done either about a pin, which is entered by the initiator and transmitted to the signer, or an SMS with a code, based on the phone number, that is verified or about Windows live.

### C.14.8 Status Report

Several options are possible to receive a status report from a document:

1. Dash Board: When the user open the website and logs in, a summary is presented with tasks to do and the amount of documents in the different states.
2. Mail: In the settings it is possible to set the option to track the actions done on a document with mail notifications.
3. Separate view: Inside the web application a separate view exists for documents. There they are sorted based on their status and the date send. Here the user also can do a filtering for specific criteria or names. Moreover, the status is presented through icons.

### C.14.9 Availability of Document

There are several methods to get the document for persons having an account at eSignAnyWhere:

- Portal: The users can download the document from the web application at the view for documents. There they also can see the audit-trail, which shows the actions done with the document.
- Backup: Inside the settings the user can download all documents associated to the user as backup.
- Mail: All persons involved or notified by the document signing receives a mail when the document is completely signed. Inside the mail is a link to the document. It could be downloaded from there. The link is only three months after completion active.

For persons without an account, only the mail method is available.



### **C.14.10 Personal Impression**

In general the web application is intuitive to use and has a lot of functionalities for a company like cc, but the Apps are confusing for testing, because there are several available and there exists no description which to use when. Furthermore, problems with the mail invitation occurred during testing. It happened that mails had a long delay or are not sent and need to be resent. Once it was the issue that there was no content in the mail displayed, so that the user could not sign the document. But there is a good user guide available.

### **C.15 Price Information PandaDoc**

## PandaDoc Follow-up for Pia

# Thank You!

---

Hi Pia,

I appreciate you taking the time to explore PandaDoc today. I look forward to continuing to work with you as you go through this evaluation.

Below you will find a quick list of the follow-up items we discussed as well as a pricing breakdown.

If you have any questions please do not hesitate to reach out to me. You can forward this document onto anyone else who might need to view it using the "forward button" on the right-hand side of the screen.

Cheers,

**Olivia Van Wormer**

Account Executive

olivia@pandadoc.com


1-650-667-6692

- **GDPR Compliance:** <https://www.pandadoc.com/gdpr/>
- **Developer Link:** <https://developers.pandadoc.com/>
- **eSignature Legality:**
- <https://go.pandadoc.com/getstarted/esignatures/>



---

## List Price



Name	Annual Price	Number of Users	Subtotal
Enterprise Plan (\$75/monthly/user) <i>Includes at no extra cost:</i> <ul style="list-style-type: none"> <li>• Unlimited templates, documents &amp; eSignatures</li> <li>• Document analytics</li> <li>• Document builder and editor</li> <li>• Custom branding</li> <li>• Pricing tables and product catalogs</li> <li>• Integrations with CRMs and other tools</li> <li>• Content library</li> <li>• Manager approval workflow</li> <li>• Document expiration settings</li> <li>• Auto reminders</li> <li>• Content conversion assistance</li> <li>• Grand total</li> <li>• Multiple teams and workspaces</li> <li>• Custom roles and granular permissions</li> <li>• Content locking</li> <li>• Document embedding option</li> <li>• Content usage reporting</li> <li>• Custom integrations via API &amp; SDK</li> <li>• Bulk send</li> </ul>	\$900.00	80	\$72,000.00
API Envelopes <ul style="list-style-type: none"> <li>• The prices changes depending on the volume of documents. This is the price estimating 2,400 annually.</li> </ul>	\$1.00	2,400	\$2,400.00

Implementation & Onboarding			
<div>Sales Accelerator Onboarding</div> <div>Your team's efficiency around contracts, quotes, &amp; proposals can be a game changer. A PandaDoc Customer Success Manager will assess your organization's sales transaction process and set up your workspace to give you that competitive edge.</div> <div><b>What you can expect from onboarding:</b><ul style="list-style-type: none"><li>- Access to support</li><li>- Deployment kick-off call</li><li>- On-brand design template theme created</li><li>- Sales process assessment</li><li>- CRM/integration assistance</li><li>- Pricing table and product catalog setup</li><li>- Administrator training</li><li>- Team training</li><li>- <b>Up to 15 pages</b> of content converted</li><li>- Deployment of <b>up to 2 workspaces</b></li></ul></div> <div><b>**Onboarding services expire within 60 days of purchase</b></div>	\$1,500.00	1	\$1,500.00
			Subtotal \$75,900.00
			Total \$75,900.00

# Your Price

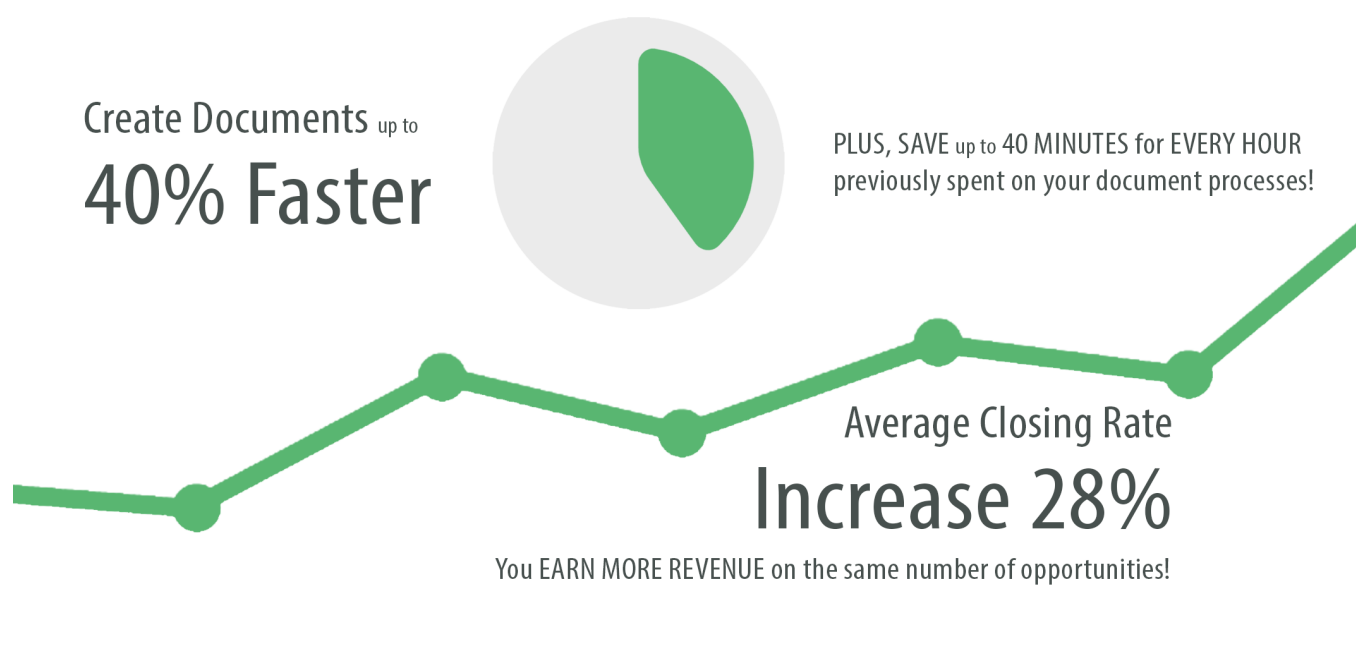
Please be aware that the prices above are**LIST PRICE** and **there is always room for negotiation** 😊

We want to earn your business and are happy to compete with the prices of our competitors. Just provide us with the price quote you received from a competitor and we'll do our best to meet, or beat, their price.

Please continue scrolling for your custom Price Quote:

Name	Price	Number of Users	Subtotal
Enterprise Plan (\$45/month/user) <i>Includes at no extra cost:</i> <ul style="list-style-type: none"><li>● Unlimited templates, documents &amp; eSignatures</li><li>● Document analytics</li><li>● Document builder and editor</li><li>● Custom branding</li><li>● Pricing tables and product catalogs</li><li>● Integrations with CRMs and other tools</li><li>● Content library</li><li>● Manager approval workflow</li><li>● Document expiration settings</li><li>● Auto reminders</li><li>● Content conversion assistance</li><li>● Grand total</li><li>● Multiple teams and workspaces</li><li>● Custom roles and granular permissions</li><li>● Content locking</li><li>● Document embedding option</li><li>● Content usage reporting</li><li>● Custom integrations via API &amp; SDK</li><li>● Bulk send</li></ul>	\$540.00	80	\$43,200.00
API Envelopes <ul style="list-style-type: none"><li>● The prices changes depending on the volume of documents. This is the price estimating 2,400 annually.</li></ul>	\$1.00	2,400	\$2,400.00

Implementation & Onboarding			
<p>Sales Accelerator Onboarding</p> <p>Your team's efficiency around contracts, quotes, &amp; proposals can be a game changer. A PandaDoc Customer Success Manager will assess your organization's sales transaction process and set up your workspace to give you that competitive edge.</p> <p><b>What you can expect from onboarding:</b></p> <ul style="list-style-type: none"> <li>- Access to support</li> <li>- Deployment kick-off call</li> <li>- On-brand design template theme created</li> <li>- Sales process assessment</li> <li>- CRM/integration assistance</li> <li>- Pricing table and product catalog setup</li> <li>- Administrator training</li> <li>- Team training</li> <li>- <b>Up to 15 pages</b> of content converted</li> <li>- Deployment of <b>up to 2 workspaces</b></li> </ul> <p><b>**Onboarding services expire within 60 days of purchase</b></p>	\$1,500.00	1	\$1,500.00
			Subtotal \$47,100.00
			Total \$47,100.00

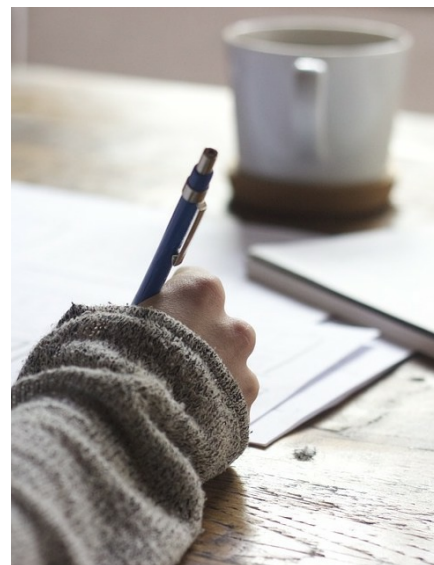


# Wondering About the Competition?

---

To see some side-by-side comparisons between us and our competitor, take a look here: <https://www.pandadoc.com/alternatives/>

Also, if you want to see how we rate on G2Crowd: <https://www.g2crowd.com/categories/proposal>





## **C.16 Price Information DocuSign**



## **Executive Proposal for: codecentric AG**

Valid Until: April 30, 2018

Prepared by: Dominik Groth  
Email: [dominik.groth@docusign.com](mailto:dominik.groth@docusign.com)  
Phone: +353 85 2866585

EMEA Executive Sponsors: Charlie Weijer, Area VP EMEA Commercial Sales

**DocuSign**®

# Contents



- DocuSign Investment Proposal
- Start Up Costs

# DocuSign Investment Proposal - 1 Year Te

Subscription & Support Costs for Amount of Envelopes purchased annually upfront			
Contract Period	Product	Quantity	Cost/Unit
Year 1	DocuSign Business Pro Including 15% Support	2,400	€ 3.37/Envelope
Year 1	DocuSign Retrieve		€ 3,735.00
Year 1 Total			€ 11,823.00

### Definition of an Envelope:

For reference, an envelope constitutes a transaction and can involve one or multiple signatories, documents, and pages as long as they are contained in the same sending event and routed along the same workflow sequence.

### Definition of Retrieve:

DocuSign Retrieve is a windows-based tool that "retrieves" envelopes, documents, and data from DocuSign for use in external systems. Retrieve runs on your system and can be run as one-time request or on a schedule. When run, Retrieve contacts DocuSign, and retrieves envelopes, documents, and information for those envelopes based on filters you set.

### Deliverables:

- DocuSign Business Pro Edition Product (Includes open API access) - **€ 2.93 per Envelope**
- Premier Support across time zones (with a 4 hr. response SLA) - **15% of Envelope Pricing**
- Unlimited Users & Signers
- Complimentary Envelope Storage



# DocuSign Start Up Costs & Professional S

One Time Services Costs	
Product	Cost
Basic Onboarding & Admin Training (Required)	€1,250.00

Services Details:

- **Basic Onboarding**
  - Dedicated Adoption Consultant for first 90-days of subscription period
  - Adoption Consultant will provide project management between onboarding resources, admin training, and general use case consulting and development support



## **C.17 Price Information HelloSign**



## API & Enterprise Plan Service Agreement

Prepared for

# Codecentric

## Summary

Pia,

On behalf of HelloSign, we are excited to work with Codecentric to help simplify your document signing experience.

As you explore the power of HelloSign, we are proud to offer free access to our Customer Success and API Support teams to maximize your user experience. If you're unsure who is the right team to contact reach out to Customer Success. They'll help you land in the right place to get help as quickly as possible.

Based on our conversations, I have put together this detailed quote outlining the start of our exciting business relationship together.

Please let me know if you have any questions.

Best regards,

Jack Dauer  
Senior Account Executive

---

### About HelloSign

HelloSign simplifies work for millions of individuals. Over 65,000 companies world-wide trust the HelloSign platform – which includes eSignature, digital workflow and electronic fax solutions with HelloSign, HelloWorks and HelloFax – to automate and manage their most important business transactions.



For more information visit <http://www.hellosign.com>



# Quote Terms

DATE: 4/30/2018

ATTENTION: Pia Erbrath

COMPANY: Codecentric

ADDRESS: Please provide, and I will add.

Jack Dauer  
jack.dauer@hellosign.com  
(415) 697-2529

PROJECT DETAILS: API Gold Plan with 450 monthly signature requests & 80-seat enterprise web app plan

Description	Monthly Price (list)	Duration (months)
HelloSign API Gold Plan	\$449.00	12
450 API Signature Requests/Month		
15-Templates		
Data Deletion		
OAuth		
Embedded Signing		
Embedded Requesting		
Advanced Signing Tools		
<b>Terms:</b>	Subtotal (Annual)	\$5,388
- Expiration: Pricing and conditions expires on 5/31/18.	Discount	20%
- Payment: Annual subscription requires payment in full for the first 12 months	Monthly Payment (After Discounts)	\$359
- Discount applicable for 12 months of service.	TOTAL (Annual Payment)	\$4,310

- Terms Of Service: [www.hellosign.com/legal/api-terms](http://www.hellosign.com/legal/api-terms)

Description	Quantity (seats)	Cost (per seat)	Monthly Price (list)	Duration (months)
HelloSign Enterprise Plan	80	\$24.00	\$1,920	12
Unlimited Documents				
Unlimited Support				
Unlimited Storage				
Audit Trail				
Data Validation				
Status Notifications	Salesforce Integration			
Integrate w/ Google Drive	HIPAA and SOC 2			
In-Person Signing	Advanced Features			
Branding	Adv. Admin Features			
Team Transaction Overview	User Reporting			
Signer Access Code				
<b>Terms:</b>			Subtotal (Annual)	\$23,040
- Expiration: Pricing and conditions expire on 5/31/18			Non-Profit Discount	20%
- Payment: Annual subscription requires payment in full for the first 12 months via credit card			Cost Per Seat (After Discount)	\$19
- Discount applicable for first 12 months of service.			Monthly Payment (After Discounts)	\$1,536
- Terms Of Service: <a href="http://www.hellosign.com/legal/tos">www.hellosign.com/legal/tos</a>			Total (Annual Payment)	\$18,432

## Codecentric

NAME: Pia Erbrath

TITLE:

SIGNATURE:

## HelloSign, Inc

NAME: Jack Dauer

TITLE: Senior Account Executive

SIGNATURE:

# Support & Services

## INCLUDED WITH SUBSCRIPTION

**Test Account**

**API Documentation**

**Customer Support**

**Customer Success**

## DETAILS

**Free API Testing**

**Unlimited**

**Email, Chat, Forum**

**Designated Success Manager**

## COST

**Included**

**Included**

**Included**

**Included**

## Concierge Level Support That's Included

We understand that every deployment is unique and requires concierge-level support to be successful. You will be assigned a designated Customer Success Manager who will work closely with you to ensure that your implementation is successful. In addition to your Customer Success Manager, API customers will get access to the HelloSign API Support Team for technical questions and assistance.

Customer Success and API Support are available Monday - Friday from 9:00am - 5:00pm PST. HelloSign also offers Professional Services to help set up complex deployments. Contact your account representative for pricing and additional details.

### API Support Team

- Developer Support - have your developers talk with a developer who specializes in the HelloSign API
- Technical, use case, and implementation questions directly related to the API
- Engaged and invested in working together to improve the developer experience as well as the business user experience with our API's
- Your point of contact for pressing needs and troubleshoot errors you or your customers receive
- Performs the App Approval for embedded workflows

### Customer Success Manager

- Questions about your implementation
- Product feedback/feature requests
- Best practice recommendations for streamlining solutions to problems you want to solve using HelloSign
- Billing/upgrade-related questions
- Provide proactive outreach ranging from product updates to strategic suggestions based on your usage patterns

## Awards & Recognition



## 10 Reasons Why Our Customers Love Us

1. World-class API documentation
2. Best-in-class end user experience & support
3. Built to be embedded (Embedded Templates for your customers)
4. Great UI and powerful platform
5. Fastest rate of innovation - New releases every three weeks
6. True White Labeling - No "Powered by HelloSign"
7. #1 e-signature for small businesses (2018 G2crowd report)
8. Competitive Pricing (DocuSign, where you at?)
9. Security-focused (SOC 2, HIPAA, Audit Trails, and more)
10. Mobile-first document workflow automation

### Here's what our customer are saying:

*"We looked at all the top-tier providers and HelloSign had the cleanest API by far. With all the others it was too difficult to build what we wanted."*

**- Vivek Shah**  
CEO, Co-Founder of SimplyInsured

*"We wanted an API built by a team that valued user experience as much as we do. At the end of the day we chose HelloSign because it was the best combination of features, price and user experience."*

**- Max Mullen**  
CEO, Co-Founder of Instacart

### Trusted by:



# Security

## Our First Priority

Everything we do at HelloSign is done with security top of mind. We are proud to be a SkyHigh CloudTrust provider with the highest rating of “Enterprise-Ready” status and 99.9% uptime. We are compliant with all major eSignature laws including ESIGN, UETA, and European eIDAS. Our SSL encryption, world-class server infrastructure, and audit trails ensure that your documents are kept safe and secure. Finally, multiple layers of authentication verify every signer’s identity and documents are encrypted using AES 256-bit encryption.

**Here are a few things we do to make sure your data is secure.**

- SOC 2 Type I
- HIPAA
- All documents are encrypted at rest using AES 256-bit encryption
- For any document in transit to be signed, all communications are encrypted using SSL/TLS
- All backups are encrypted
- HSTS is enabled (HTTP Strict Transport Security)
- All passwords are hashed and salted
- HSTS is enabled (HTTP Strict Transport Security)
- All passwords are hashed and salted
- Penetration testing is done by an independent third party
- Hosting in a state-of-the-art SSAE 16 audited facility that is also ISO 27001
- Audit Trails
- Role-based security
- All transactions are legally binding (documents post-signing are non-editable)
- Private Bug Bounty program with HackerOne (same as US Pentagon)



## **C.18 Price Information eSign Live**



Pia Erbrath &lt;pia.erbrath@codecentric.de&gt;

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## eSignLive enquiry

---

**Matteo Molé** <Matteo.Mole@vasco.com>

7. Mai 2018 um 12:47

An: "pia.erbrath@codecentric.de" &lt;pia.erbrath@codecentric.de&gt;

Cc: Filip Joly &lt;Filip.Joly@vasco.com&gt;, Phillip Wood &lt;phillip.wood@esignlive.com&gt;

Dear Pia,

My name is Matteo and I am the Customer success representative for the EMEA region for eSignLive.

With regard your requests addressed to Filip Joly, please find below the pricing both for our Enterprise Subscription Plan and our Professional Subscription Plan.

Enterprise plan:

Transactions	Transaction Tier	Price per transaction	Total cost
2400	1000 to 4999	€ 2,35	€ 5640

This plan include the access to our API and SDK

Professional Plan (user based):

Users	User Tiers	Price per user	Total cost
80	50 - 99	€ 171	€ 13680

Please do not hesitate to get back to me should you need further information

Kind regards

**Matteo Molé**, Customer Success Representative - EMEA

eSignLive™ by VASCO – When e-signatures matter to your business

Tel: +32 26099712

E: [matteo.mole@vasco.com](mailto:matteo.mole@vasco.com)Join the conversation: [Blog](#) | [Twitter](#) | [LinkedIn](#) | [Facebook](#) | [Google+](#)



## **C.19 Price Information eSignAnyWhere**





Pia Erbrath &lt;pia.erbrath@codecentric.de&gt;

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## Fragen zu eSignAnyWhere (inc Pricing)

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Klaus Fellner <klaus.fellner@xyzmo.com>  
An: Pia Erbrath <pia.erbrath@codecentric.de>

3. Mai 2018 um 17:12

Hallo Frau Erbrath

Hier gilt dann:

Code	Product	Unit	Volume	Price p.a.
---	HTML5 Client for Click2, Type2 or Draw2Sign	Envelope Allowance	< 2.500	Not available
SAW-041-AS			2.500	3.000 EUR
SAW-042-AS			5.000	6.000 EUR

**Envelop Allowance** - Is defined as the allowance to send a predefined amount of envelops in a defined period (e.g. a year). Not consumed envelops cannot be transferred to the next period and are not refunded.

The following is included in shared SaaS: SMS sending and document conversion + Simple Office Uploader + Cloud drive access (e.g. GDrive)

User Limit gibt's dann keines.

Add-Ons gibt's für:

- Connectoren
  - Word (one-way)
  - Outlook (one-way)
  - SharePoint (bi-direktional)
  - Dynamics (bi-direktional)
  - Salesforce (bi-direktional)
- Biometrische Unterschriften

Freundliche Grüße

Klaus Fellner

**Von:** Pia Erbrath <[pia.erbrath@codecentric.de](mailto:pia.erbrath@codecentric.de)>

**Gesendet:** Mittwoch, 2. Mai 2018 10:54

**An:** Klaus Fellner <[klaus.fellner@xyzmo.com](mailto:klaus.fellner@xyzmo.com)>

**Betreff:** Re: Fragen zu eSignAnyWhere (inc Pricing)

[Zitierter Text ausgeblendet]

## Appendix D

# Mathematical Code Representation Rule Set Request

Existing datasets:

- $A = \text{set of positions at the company}$
- $B = \text{set of document types at the company}$
- $C = \{(c_1, c_2) | c_1, c_2 \in R_0^+, c_1 < c_2\}$  // set of different value ranges for documents
- $D = \{(a_1, \dots, a_n) | a_i \in A\}$  // set of different signing groups
- $E = \{(b, (c_1, c_2), (d_1, \dots, d_n)) | b \in B, (c_1, c_2) \in C, (d_1, \dots, d_n) \in D\}$  // set with signing rules containing document specification, value range specification and signing group

Function:

```

function F(x,y,z) with the following conditions:  $x \in B \wedge z \in A \wedge y \in R_0^+$ 
  if  $\exists b \in B, b = x \wedge \exists a \in A, a = z$  then
    docs =  $\{(c_1, c_2) | (b, (c_1, c_2), (d_1, \dots, d_n)) \in E, b = x\}$ 
    i, j
    for all  $(c_1, c_2) \in \text{docs}$  do
      if  $c_1 \leq y \leq c_2$  then
        i  $\leftarrow c_1$ 
        j  $\leftarrow c_2$ 
      end if
    end for
    groups =  $\{(d_1, \dots, d_n) | (b, (c_1, c_2), (d_1, \dots, d_n)) \in E, b = x, c_1 = i, c_2 = j\}$ 
    inGroup[groups]
    for all  $(d_1, \dots, d_n) \in \text{groups}$  do
      if  $z \in (d_1, \dots, d_n)$  then
        inGroup[(d1, ..., dn)] = (d1, ..., dn)
      end if
    end for
    if |inGroups| > 0 then
      for k  $\leftarrow 0, |inGroups|$  do
        if inGroups[k]  $\notin \emptyset$  then

```

```
        return inGroups[k]  
    end if  
end for  
else  
    return error: no value range found for value  
end if  
else  
    return error: position/document type does not exists  
end if  
end function
```

## Appendix E

# Definition of Done

- The requested functionalities are all implemented
- Code and Build Management
  1. Everything compiles without errors and warnings
  2. Sources are under version control in Gitlab
  3. Build dependencies are explicitly managed with Maven
- Testing
  1. Unit tests exist and are green
  2. Integration tests exist and are green
  3. Application has been manually tested
  4. Browser independent testing is done for Chrome and Firefox
- Quality
  1. Code is refactored for maintainability
  2. Clean Code ([https://de.wikipedia.org/wiki/Clean\\_Code](https://de.wikipedia.org/wiki/Clean_Code))
  3. SOLID (<https://en.wikipedia.org/wiki/SOLID>)
  4. Code documentation (class, method, diagrams)
  5. Documentation exists and is up-to-date
  6. User documentation
  7. Admin documentation
  8. Developer documentation
  9. Code satisfy the coding guidelines based on the following link: <https://google.github.io/styleguide/javaguide.html>

## **Appendix F**

### **Product Backlog**

Story	Sprint	Status	Estimated Time	Needed Time
1 As a User, I want to login		1 Done	16 h	6 h
2 As a user I want to select a document from my ERP based on a part of the name (document/customer/type) I give the system		1 Done	24 h	40 h
3 As a user I want to get the information, who had to sign the document beside of me		2 In Progress	48 h	
As a user I want to prepare the document to sign				
As a user I want to send the document to sign by others				
As a user I want to keep informed about the document status/ signing process				
As a user I want to archive the signed document automatically				
As a user I want to change my password				
As an admin user I want to create a new account				
As an admin user I want to delete an account				
As a User I want to upload documents from my computer				
As a user I want to archive documents manually				
As a user want to get an overview of my recently uploaded documents in the ERP				

Figure F.1: Product backlog with all User Stories and Sprint Backlogs

## Appendix G

# User Management Server File

```
dn: ou=codecentric ,dc=codecentric ,dc=com
objectclass: top
objectclass: organizationalUnit
ou: codecentric
```

```
dn: ou=groups ,ou=codecentric ,dc=codecentric ,dc=com
objectclass: top
objectclass: organizationalUnit
ou: groups
```

```
dn: ou=people ,ou=codecentric ,dc=codecentric ,dc=com
objectclass: top
objectclass: organizationalUnit
ou: people
```

```
dn: uid=john.doe ,ou=people ,ou=codecentric ,dc=codecentric ,dc=com
objectclass: top
objectclass: person
objectclass: organizationalPerson
objectclass: inetOrgPerson
cn: John Doe
sn: Doe
mail: johnathan.doe@web.de
uid: john.doe
userPassword: john.doe
```

```
dn: cn=employee ,ou=groups ,ou=codecentric ,dc=codecentric ,dc=com
objectclass: top
objectclass: groupOfNames
cn: employee
member: uid=john.doe ,ou=people ,ou=codecentric ,dc=codecentric ,dc=com
```



## Appendix H

# Classdiagrams Mocked Components

### H.1 User Management Mock

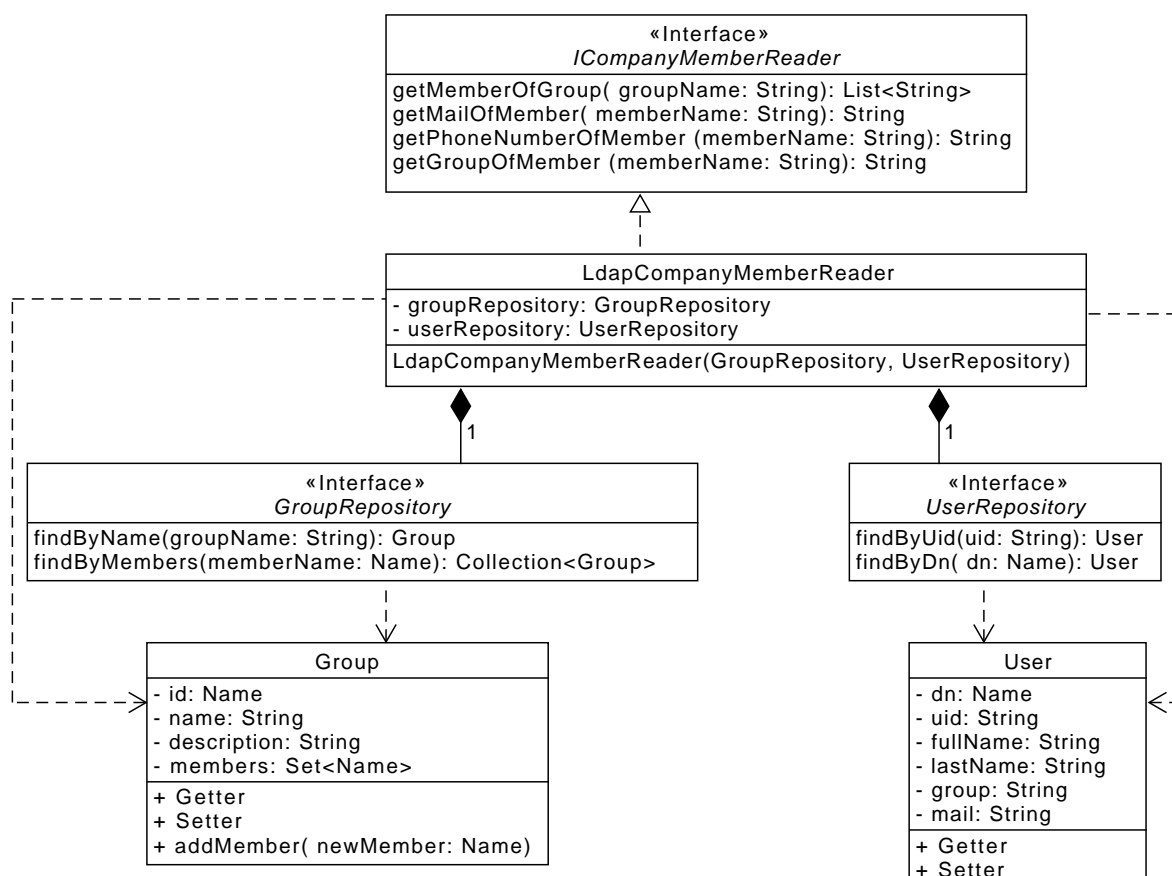


Figure H.1: Classdiagram LDAP Reader

### H.2 Rule Set Mock

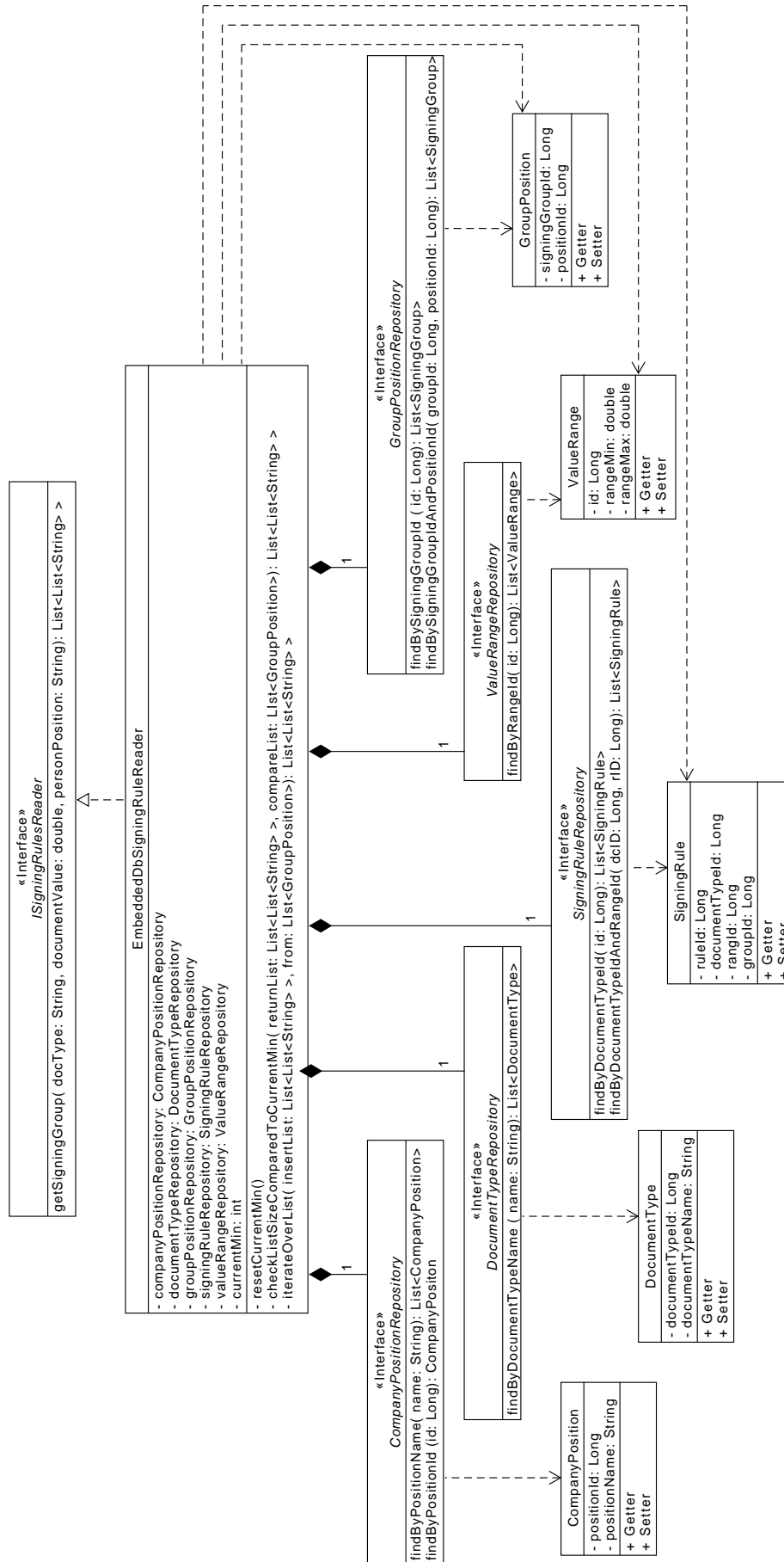


Figure H.2: Classdiagram Rule Set Reader