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# Maximum Payment Limit Workflow Improvement

Metropolia University of Applied Sciences

Master's Degree

Degree Programme in Business Informatics

Master's Thesis

10.11.2023

## Abstract

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Title: Maximum Payment Limit Workflow Improvement  
Number of Pages: 75 pages + 7 appendices  
Date: 10 Nov 2023

Degree: Master of Business Administration  
Degree Programme: Business Informatics

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The objective of this thesis was to create a maximum payment limit workflow improvement plan. The plan guides the development process inside the Apotti-system. The need for improvement was identified in the case organization based on feedback from the end users who are the welfare area customer fee unit employees.

The study was done by using the applied action research approach. The data for this study was gathered by using the questionnaire, interviews, workshops, and internal documents. The current state analysis identified two types of problems related to the maximum payment limit workflow: usability and time. The workflow was seen as partially slow, and some tools did not work similarly in all the parts of the process. The theoretical framework focused on exploring the topics related to usability and time as part of the business process improvement.

The outcome of this thesis was an improvement plan that proposed how to resolve the two pain points, improving usability and time, based on co-creation with the end-user organization, including the Apotti application coordinators and end-users.

The improvement plan included such proposed actions as improving the reporting to include more data from different sources and having a calculator inside the report to speed up the inspection phase. Workqueue will catch more residents to be inspected by the end-user and there will be a possibility to add other welfare areas invoices to the system for reporting purposes, also the maximum payment limit certificate will be improved to have more data and different versions. The plan also included the planned schedule for implementation. The proposed improvements, when implemented should help the case company and its customers by offering a better and faster service with improved usability. By streamlining this process, the organization can improve its productivity and better focus its employees on what truly matters.

Keywords: Process improvement, Lean methodologies, User centric design

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## **Glossary**

CTQ	Critical to Quality
DPMO	Defects Per Million Opportunities
DMAIC	Define, Measure, Analyze, Improve, Control
ERP	Enterprise Resource Planning
EPR	Electronic Patient Record
HR	Human Resources
IT	Information Technology
PDCA	Plan, Do, Check, Act
TQM	Total Quality Management
UX	User Experience
UCD	User-Centric Design
UI	User Interface

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# 1 Introduction

Information systems are used on various areas of administrative work. Nowadays a lot of different workflows are digitized with the idea of making the daily work more fluent. Different workflows might have bottlenecks, the current tools might not be optimized completely, or the workflows might be done by using a lot of different information systems. Identifying these bottlenecks and finding the solution is important when company is trying to maximize its potential.

This thesis will compile a development plan to the case company on how it can offer their customers a solution which will help the end users to be more efficient, when working with the maximum payment limit workflow.

## 1.1 Business Context

The case company is Oy Apotti Ab, which is a Finnish healthcare IT company owned by stakeholder welfare areas and one healthcare district HUS. Apotti is simultaneously a company, a project, and a healthcare IT-system. The company was born when the stakeholder municipalities and HUS recognized the need to develop the first electronic client and patient record ERP system that would combine health care and social care in one system. The Apotti-healthcare system is currently used by approximately 47 000 professionals on various fields. (Apotti, 2022)

*“The biggest economic advantages brought by the Apotti system come from changes in operational routines and more effective data utilization”  
(Apotti, 2022)*

The Apotti-system is used in various administrative works which include hospital billing. Economy secretaries, billers and other end users that work with Apotti-system handle the invoices and other billing material, which is generated by the work done, for example in the hospitals. One of their tasks is to research, if a resident is applicable for the nationwide maximum payment limit certificate, which is used in Finland. To do this, they use tools that are available in the Apotti system.



## 1.2 Business Challenge, Objective and Outcome

Welfare areas in Finland have a nationwide maximum payment limit, which is also known as a payment ceiling. It is the maximum amount that can be charged annually per person for public health- and social services. After the amount that is valid for the current year has been reached by a resident, they will receive a certificate to prove that the maximum payment limit has been reached. After receiving the certificate, specific services will be cheaper or free of charge. (STM, 2022)

Welfare areas often have an administrative department, called customer fee unit, which handles these maxpayment limits. The economy secretaries in these departments use different information systems to calculate, whether the resident can receive the maximum payment limit certificate.

The challenge in the workflow arises from the utilization of numerous information systems for a single task, leading to bottlenecks due to a lack of communication among these systems. The workflow requires a lot of investigating, so making the data query quicker and the results clear regarding the information needed would benefit the end users. Since the end users have other tasks on their daily work, making one of them more efficient will give them time to put more time on the other tasks.

This thesis aims to find out the reasons and bottlenecks that make the current workflow slow. It aims to understand what needs to be done, so that the workflow becomes quicker.

The Objective is to propose *a plan on how to improve the workflow so that to proceed with the necessary build in 2023 and 2024* (including the improvements to the process and the tools, reports, calculations, and documents).

The Outcome is a *development plan that contains the specification for the improvements for the workflow on how to proceed during the years 2023/2024*.

### 1.3 Thesis Outline

The scope of this thesis is to develop a workflow improvement plan for the Apotti stakeholder municipalities that use Apotti system. This thesis will be done with respect to the case company's internal rules.

This thesis is divided into seven sections. The first section will introduce the topic. The second section will explain the methods and materials used for this thesis. The third section will cover the results from the current state analysis of the workflow. The fourth section will discuss best practices and existing knowledge on the focus areas selected based on the results of CSA. The fifth section describes the co-creation of the improvement document with the stakeholders based on the findings from sections three and four. The maxpayment limit workflow improvement plan is presented to the necessary stakeholders in the section six. The seventh section is dedicated to concluding the thesis.

## 2 Methods and Materials

This section will describe what kind of approach, design, data collection and analysis methods are used in this thesis.

### 2.1 Research Approach

Research is carried out to discover new facts and insights; for example, to test new products and services, to predict the future, or to tackle an organizational challenge. Researcher may apply different research methods to obtain the best answers to their research questions. Researcher will decide which combination of methods serves the end goal of the study the best.

As for the *research families*, when the need to decide about a specific problem or a question that has occurred in real-life, *applied* research is conducted. Applied research aims to generate a better understanding on the topic at hand. (Adams et al. 2014, 7.) On the contrary, *pure, or fundamental* research is used to create new knowledge which advances our understanding of the real world. It attempts to expand the limits of existing knowledge. Moreover, two main domains of research, broadly speaking, are qualitative research and quantitative research (Adams et al. 2014, 1-7). *Qualitative* research concentrates on describing reality and therefore the methods for data collection and analysis are non-quantitative and aims to describe reality through the experience of the respondent. This research method has history of being used widely on the field of social sciences (Adams et al. 2014, 6). *Quantitative* research is based on objectively stated facts. (Hirsjärvi et al. 2004, 135.) Quantitative research is applied to measure quantitatively and therefore statistical analysis is used. To collect the data, for example questionnaires and surveys can be used (Adams et al. 2014, 6).

As for the *research strategies*, action research and case studies are especially widely known. Action research rather researches in action, than does research about action. Action research uses scientific approach to study the problems directly with those who experienced the problems. (Coghlan, Brannick 2014, 6). A somewhat similar research method is case study. Case study aims to understand and examine a real-life case to understand a larger set of similar cases. Case study is useful when closely describing and documenting events as they unfold in a setting that happens in a real life (Simons,

2009, 19-23). One of the latest research approaches, especially used for thesis research, is Applied action research. Applied action research is a group of different research methodologies, which are used based on the objective for development needs. Applied action research is similar to the development work that is done inside organizations when operations are improved. These improved operations can be products, activities or processes for example. When data is carefully collected and analyzed based on research methods, the work becomes research work and produce dependable results. (Kananen, 2013, 20-22.)

This thesis will use Applied action research as the research approach since the main goal is to produce a practical result that improves this part of the process to be better. To identify the problems on the workflow, there is a need to gather data from the end-users who currently work with the part of the process, which uses Apotti System. Interviews are major part of the data collection phase alongside workshops and questionnaire. Interviews and workshops will be documented by field notes.

## 2.2 Research Design

This part explains the structure of the research design. Figure 1 below shows the sources of data and the planned outcome of each step.

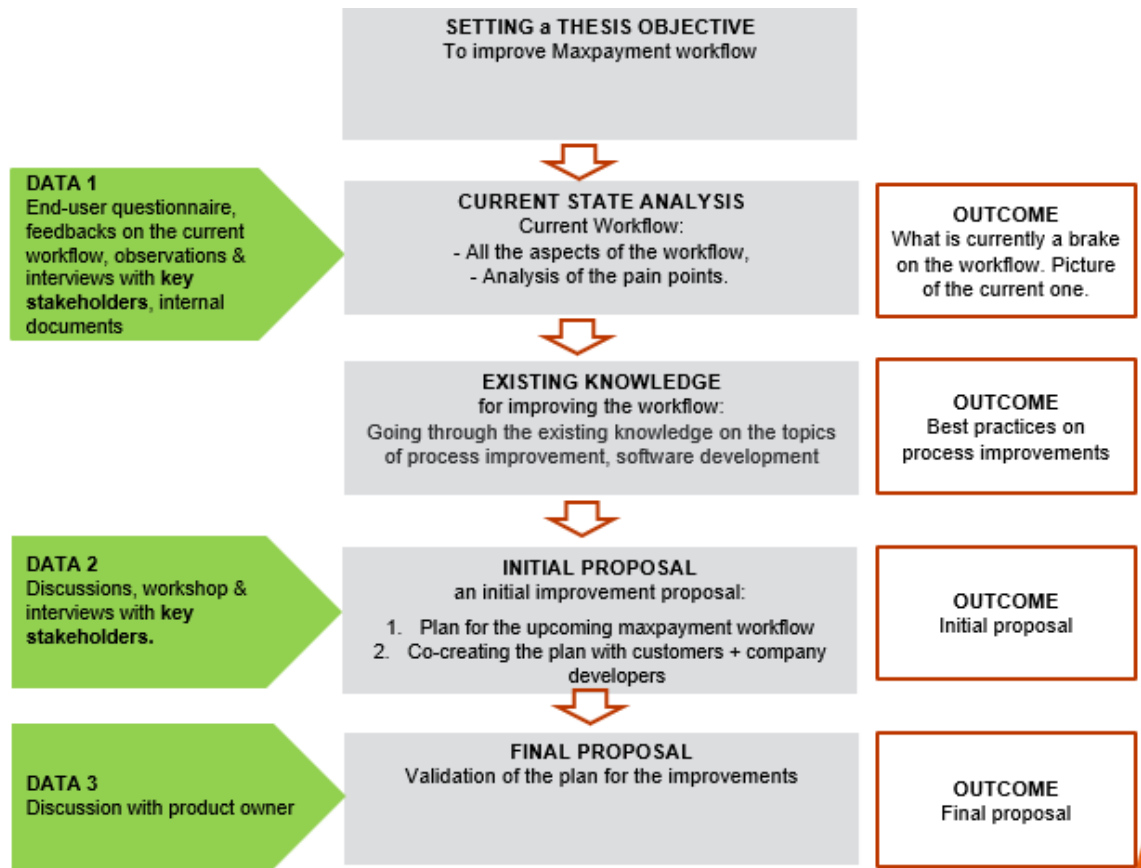


Figure 1. Research design of this thesis.

As shown in Figure 1, the thesis starts with setting the objective. Next, the current situation will be evaluated and explored on all angles by doing interviews, observations, document analysis, and questionnaire with the current end users. The current state analysis gathers the data for identifying how the workflow currently is done and where are the pain points.

After that, the study focuses on exploring the existing knowledge and best practice on the workflow pain points that can be tackled via gaining knowledge on process improvement and software development.

With the information selected from best available knowledge (Section 4) and the current state analysis results (Section 3), the study then starts co-creating the development plan with the relevant stakeholders. The workflow's different parts, where possible, will be developed to a leaner model with the help of Apotti developers and the stakeholder municipalities, and the end users of the workflow.

In the validation stage, if found possible, the study pilots/tests some new tools on a trial basis and reports the feedback and results from initial improvement. With the steps taken, the development plan is finalized.

### 2.3 Data Collection and Analysis

This study draws from a variety of data sources, and the data was collected in several data collection rounds. For the current state analysis, questionnaire was formed and sent to the end users of the workflow. Product manager of Apotti was interviewed to gain understanding about the matter. Documents from one welfare area was reviewed as well as internal documents inside Apotti. Workshop was conducted to go through the tools that are used in the Apotti system. Workshops were also conducted to build the proposal for the improvement document. Table 1 shows details of Data collections 1-3 used in this study.

Table 1. Details of Data collections 1-3 used in this study.

Participants / role	Data type	Topic, description	Date	Documented as
<b>Data 1, for the Current state analysis (Section 3)</b>				
Internal Documentation	Review	Notes from older meetings	20.02.2023	Field notes
Economy secretary A	Questionnaire	Identified problems with the current workflow	03.3.2023	Questionnaire form
Economy secretary B	Questionnaire	Identified problems with the current workflow	03.3.2023	Questionnaire form
Economy secretary C	Questionnaire	Identified problems with the current workflow	03.3.2023	Questionnaire form
Product Manager Apotti	Interview / Teams	Going through the current workflow with the product manager	23.3 2023	Field notes
Document from customer	Review	Demand from customer including description of parts that needs improvement	30.3.2023	Ticketing system
Internal Documentation	Review	Current instructions	30.3.2023	
Application coordinators 3	Workshop	Going through the maxpayment limit workflow tools	31.3.2023	Field notes
<b>Data 2, for Proposal building (Section 5)</b>				
Participants: Three	Workshop	Proposal building	17.05.2023	Field notes

Application coordinators				
Participants: Application coordinators (4) End users (8)	Workshop/ discussion	Discussion with the end users / Proposal building	30.05.2023	Field notes
Participants: Application coordinators 3	Workshop discussion	Proposal building	07.06.2023	Field notes
<b>Data 3, from Validation (Section 6)</b>				
Product manager	Final presentation	Validation, evaluation of the Proposal	12.06.2023	Field notes and recording

The table 1 shows that the data was collected in three rounds for this Thesis. Data 1 was collected for the use of the current state analysis. By using a questionnaire and interviews, the data collection gave a clear understanding on the problems. Questionnaire was chosen to give each end user possibility to think and answer the potential problems, before going them through in a group interview conducted in teams. In the first round also, old documentation was gone through to see which parts have been seen as important.

Data 2 was collected to gather suggestions from the application coordinators and the end-user organization to gather the necessary information to co-create the improvement proposal. This was done in the second round of data collection.

Data 3 was collected when conducting validation of the initial proposal, the workflow improvement document. Data 3 included feedback for the proposal from the Product manager of Apotti. This was done in the third round of data collection.

Interviews and workshops were the main method for data collection, and they were conducted as semi-structured, online meetings that were held on Teams platform. The interviews were documented with the field notes. The questions for questionnaire can be found in Appendix A; the responses were gathered in Finnish and then translated into English. The field notes of the relevant meetings can be found in Appendix B-F, where the data is pseudo-anonymized. Thematical and content analysis was used when the textual data was analyzed.

Table 2 shows the internal documents used in the current state analysis, Data 1.

Table 2. Internal documents used in the current state analysis, Data 1.

	<b>Name of the document</b>	<b>Number of pages/other content</b>	<b>Description</b>
A	Maksukattoraportti	10 pages	Instruction on the maxpayment limit report
B	Laskutuksen tilityöjono – PTH ja STH	14 pages	Instruction on the workqueue tools
C	Maksukattoon perustuva korvauskattavuus	8 pages	Instruction on how the maxpayment limit coverage works

As seen from Table 2, this study also analyzed a number of internal documents. The documents were analyzed for Data collection 1 round, the current state analysis, to get understanding on what kind of tools are currently used inside the Apotti system and how are they instructed to the end users.

Understanding the current workflow completely was crucial in the process of improvement and therefore the current state analysis was the part that needed the most data to be collected and analyzed. The findings from the current state analysis are discussed in Section 3 below.



### **3 Current State Analysis of the Maxpayment Limit Workflow**

This section presents the current state analysis of the Maxpayment limit workflow and its analysis process. This section also aims to understand the workflow firstly from the end user's viewpoint, and secondly from the Apotti application coordinator's perspective.

#### **3.1 Overview of the Current State Analysis**

The goal of the current state analysis was to understand the current state of the maxpayment limit workflow as a whole and the part of the workflow which is done inside the Apotti system. The data was collected by using inquiry interviews, observing, and reviewing the customer demand, and analyzing the internal documentation.

Firstly, the inquiry was sent to the customers' end users which have been utilizing the workflow. Some of them have been taking part in the workflow improvement in the past year. The inquiry was done anonymously, and everyone returned them individually, so that the voice of an individual was heard. Inquiry was sent to three economy secretary and their supervisor, who also chose the ones who can represent the customer organization. Response rate was 100%. The roles these people have in their organization are economy secretary and service coordinator. They are the employees that do the workflow from start to end and their voice is seen as very important part when trying to find the parts to be improved.

Secondly, product manager in financial management services was interviewed in order to understand deeply the evolution of the workflow, the current state, and potential parts to improve. The product manager has been the person for the customer organizations to inform when there are some new changes needed. Product manager had spent a lot of time with the topic already.

Third, the customer organization sent Apotti a demand that described the needs they saw important to be improved. The document was reviewed and analyzed. The document was important part in understanding the current state analysis from the end user point of view.

Fourth, internal documents were reviewed to understand the current tools and how they were instructed to the customers currently.

Finally, the workflow was reviewed and mapped by three application coordinators in a workshop, where the workflow was performed with different variations. The time and clicks for the workflow were analyzed and counted.

### 3.2 Description of Maxpayment limit as a service

Maxpayment limit is a part of the Finnish customer payment law. Customer payment law is responsible for the customer payments in Finland. It generates 1,5 billion euros per annum. The government directs health and social care customer payment politics with legislation. The main mission of customer payments is to finance parts of the services and to guide their usage. The weight of these missions can differ with different services and social justice is taken into consideration. Social justice can be guided by making some services free of charge, having a ceiling for payments, or making the amount of payment take the residents income into consideration. (Uotinen, 2021 10-15.)

The customer payments cannot make any profit and the payment can cost, at the most, the same amount as the expenses of the service. The service provider has to know the expenses their services have and to compare them with the customer payments to meet the legislation. (Uotinen, 2021 28.)

The usage of the services is directed by making most of the preventive care free of charge in Finland. Lighter care is cheaper than heavier care; for instance, homecare is cheaper than enhanced assisted living. The payments must be reasonable, so that the amount invoiced cannot be an obstacle for using the services. The customer payments cannot move the services out of the residents' reach. (Uotinen, 2021 15.)

Public healthcare in Finland has a nationwide maximum payment limit, also called as the maximum payment ceiling. Currently (9.3.2023), the maxpayment limit is 692 euros and an index increment check is made yearly to the amount. (STM, 2022.)

The reason that maxpayment limit exists in Finland is to lighten the burden of payments in situations where a resident uses services frequently during a calendar year. To make the burden lighter, there is a maximum limit for early payments for specific services. (Uotinen, 2021 56.)

The payments that are counted in the maxpayment limit are mostly flat payments and they are mostly from healthcare services. Underage patient's invoices can be counted in their parents maxpayment limit, so then the maxpayment certificate affects all the persons that have a shared maxpayment limit certificate accumulation. (Uotinen, 2021 56-58.)

Currently, it is the resident's responsibility to follow the accumulate of the maxpayment limit payments. The resident must retain all the original payment receipts and show them, if necessary. The welfare areas also have the right to collect all necessary information to follow the filling of the maxpayment limit of a resident. When the maxpayment limit has been reached by a resident, they are eligible to a maxpayment certificate. (STM, 2022)

If the resident has paid more than the current years maxpayment limit is, he/she is justified to receive the amount that is paid over credited to them. The resident must request from the welfare area to get the overpaid amounts during the next calendar year. If the resident delays from the time limit, the resident is not eligible for credited amount. Same time limit is used when a payment occurs from a decision of an official or an insurance company after the maxpayment limit accumulation calendar year. (Uotinen, 2021 56.)

Municipalities and welfare areas have the right to gather necessary information for the maxpayment limit certification. Necessary information includes social security number, euro amounts, home municipality of the patient, and the service that has been used. The municipalities and welfare areas also have the right to gather information from private services producer without any secrecy regulations. (Uotinen, 2021 60.)

Table 3 shows the services that are currently counted to the maxpayment limit domain.

Table 3. Currently the services that are counted to the maxpayment limit domain.

<b>Services that are currently available on the maxpayment limit domain</b>	
1	Outpatient physician fees
2	Physiotherapy fees
3	Daysurgery fees
4	Hospital polyclinic fees
5	Short-term bed charges on health- and social care
6	Night- and day treatment fees

7	Rehabilitation treatment fees
8	Dental visit and procedure fees without technical fees like dental instruments for sleep apnea etc.
9	Temporary homecare and home hospital fees
10	Therapy fees and fees paid by social assistance

Also, services that are the responsibility of a welfare area to offer, that are performed by an outsourced service department are counted towards the maxpayment limit accumulation.

Table 4 shows the services that are currently not counted on the maxpayment limit domain.

Table 4. Currently the services that are not counted on the maxpayment limit domain.

<b>Services that are currently are not on the maxpayment limit domain</b>	
1	Medical transportation
2	Medical certificates
3	Laboratory and imaging tests conducted with a referral from a private sector doctor
4	Social services (excluding short-term institutional care)
5	Performance-based services
6	Service voucher co-payments
7	Transportation service co-payments
8	Fully private services not covered by the welfare region's organization.

Also, payments that are paid by insurance to the customer are not counted on the maxpayment limitation accumulation.

Below in Figure 2 is simplified mapping of the whole process.

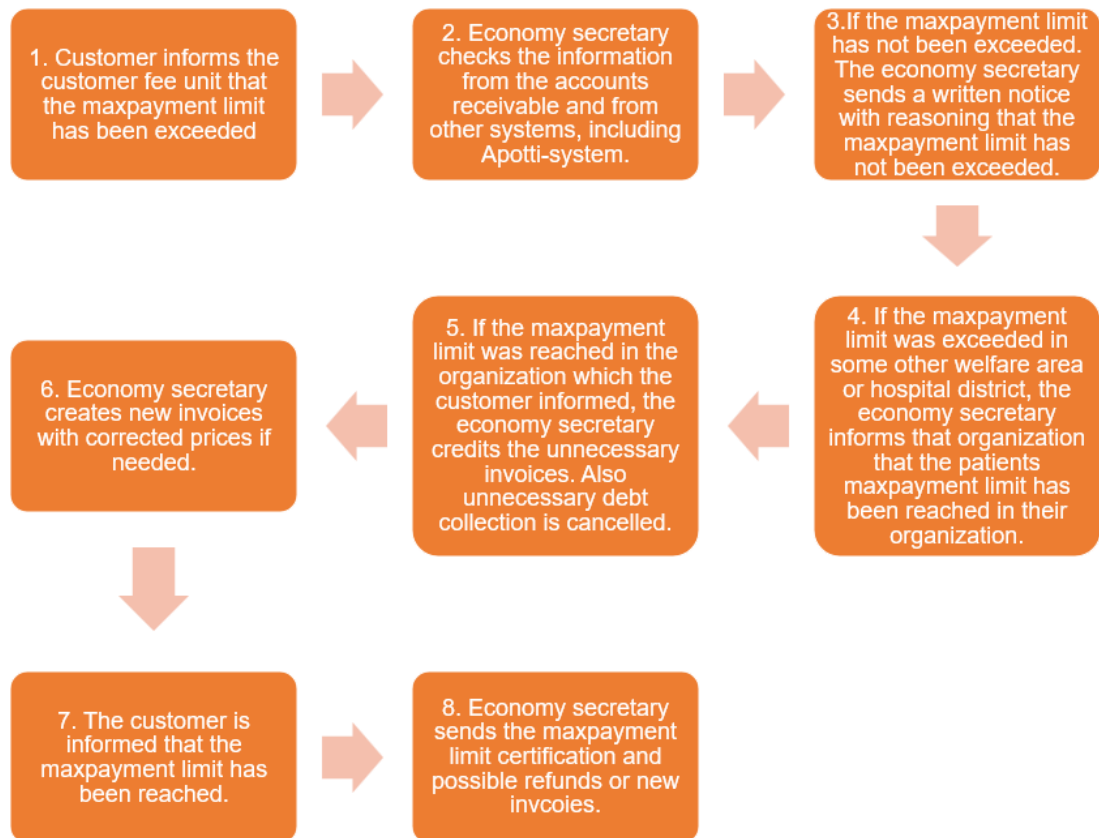


Figure 2. Maxpayment limit workflow process.

As seen in Figure 2 above, the process can be roughly put into eight main steps. First the process starts with Step 1 when the customer informs the customer fee unit. After that, in the step 2, the economy secretary starts to investigate if the resident is eligible for the maxpayment limit. If the economy secretary sees that the maxpayment limit is not reached, in the step 3, the economy secretary sends a written notice to the customer. If it was reached in other welfare area or hospital district, the economy secretary informs that organization, in the step 4, so that they can continue the work. The step 5 and 6 shows that If the limit was reached in the organization where the investigation was done, the economy secretary continues the work by calculating the exact date and then credits and possible reprices some invoices. Also, if some debt collection was active, the unnecessary ones are canceled. In the steps 7 and 8 the economy secretary informs the customer, creates the maximum payment limit certification, and send it to the customer with the new invoices if necessary.

### 3.2.1 Tools for maxpayment limit workflow inside Apotti-system

Currently, the tools used inside Apotti system include reports, workqueues and a certificate template. At the moment, health and social care are doing this workflow separately in Apotti-system, because of the configuration of the entities behaves differently in the Apotti-system.

*The maxpayment limit report* in the Apotti-system is used to gather maxpayment limit charges for the chosen patient from the current year from all the welfare areas which are currently using Apotti-system. The report is not currently gathering social care sides charges. The report is working inside the Apotti-system, and it can be exported for example to Excel or pdf -formats.

*The workqueue* used in this workflow catches patients before billing them for a secretary to investigate the possibility for a maxpayment limit certificate. The workqueue has a set of specific rules which dictates which patients are to be examined chooses the patients to be examined. The rules can be configured differently per welfare area according to their needs.

*The maxpayment limit certificate template* is a document that can be printed straight from Apotti which adds the necessary patient information straight from the patient record. It is used when the patient is eligible for the maxpayment limit and needs the official decision and document.

The feedback for these tools is found in the later parts of the CSA.

### 3.2.2 Currently Used Software in the Whole Process

The end users of the workflow currently use three other software besides Apotti system to finish the entire process. Figure 2 below shows the software used in the maxpayment limit workflow.

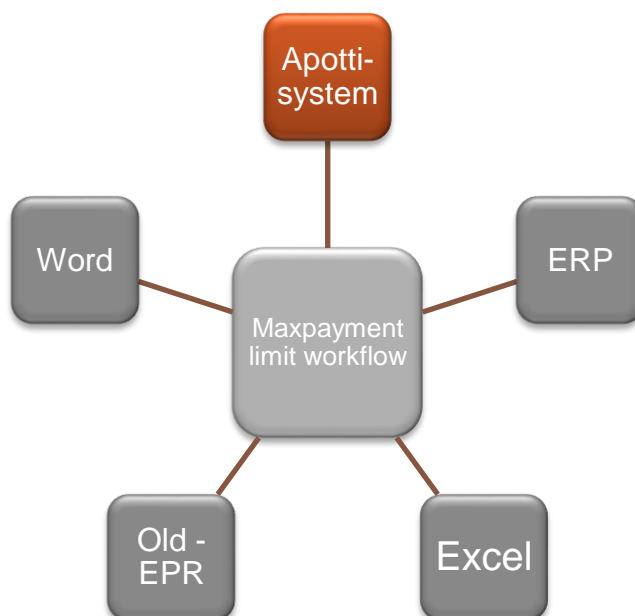


Figure 3. Currently used software in the maxpayment limit workflow.

As shown in Figure 2, these includes their ERP-system, excel, and their old EPR and word. *ERP* is used to investigate sent and paid invoices. *Excel* is used to calculate the patient's eligibility for maxpayment limit certificate with a specifically designed calculation-template. The old ERP is used to investigate the old maxpayment limit information and accumulation data Finally, Microsoft word is used to create the maxpayment limit certification which is sent to the patient.

### 3.2.3 Time Used in the Workflow

According to the answers from the questionnaire, the maxpayment limit workflow did require manual work before the Apotti implementation, and it currently needs even more manual work.

*“Manual work has increased significantly after Apotti implementation”*  
(Anonymous respondent A, 2023)

Still, some parts have become more effective from the end user perspective.

*“Some parts of the workflow have become quicker. Like after the workqueue implementation the turnaround time for some cases have become quicker”* (Anonymous respondent B, 2023)

The customer fee unit of the specific customer organization grants approximately 3026 maxpayment limit certificates to customers yearly. This was calculated based on four years information.

The turnaround time for the workflow was not calculated in detail by the end users of the workflow, but estimates were done by the economy secretaries:

1. Before Apotti, the turnaround time at its worst was 2-3 months and at its best it was 1-14 days.
2. In Apotti, the turnaround time at its worst was 3-4 months and at its best it was 11 days.

First, one of the most time-consuming part in the workflow is *gathering the maxpayment limit charges* from all the different sources. From Health care Apotti, Social care Apotti, HUS, ERP and potentially from the customer.

Another part that consumes time is *the crediting part*. When a patient has reached the maxpayment limit and received the certificate, all the invoices that are not billed with the right amount need to be credited and sometimes sent with new amounts to replace the incorrect invoices.

#### 3.2.4 Test Runs to Test Time & Usability of the Current Workflow

For this current state analysis, a Workshop was arranged to investigate the workflow from the technical perspective. In the workshop all parts of the workflow were walked through to gain a better understanding from the economy secretary perspective, time and clicks were investigated. The workshop was conducted over Microsoft Teams. The invitations for the workshop were sent one week before with the agenda included. The workshop had altogether three application coordinators, who together took time for completing the parts that currently are configured in the Apotti system. Application



coordinators has the ability to configure the Apotti-system. These were documented in the field notes. Early discussions about the possible improvements were taken as well.

Below is described typical work situations an economy secretary encounters when working with the maxpayment limit workflow inside Apotti-system.

1. The first test scenario is the part in the workflow where the end user credits and creates new invoice and adds the information for the patient that the maxpayment limit has been exceeded.
2. The second test scenario is the part where the customer has informed the economy secretary that the maxpayment limit has been reached. The economy secretary then runs the report for that specific patient to see the sent invoices from Apotti-system.
3. The third scenario is the part where the economy secretary creates and prints the maxpayment limit certificate from Apotti-system.

Figure 4 below is the first test scenario.

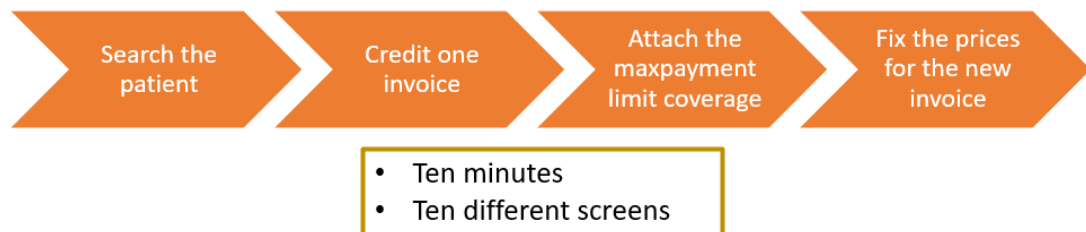


Figure 4. Test scenario 1, fixing the invoices and adding the maxpayment limit.

Figure 4 describes a situation where Apotti Application coordinator ran through the workflow in a hypothetical situation where the residents maxpayment limit accumulation was already calculated, and the Application coordinator has already the knowledge about the specific date when the maxpayment limit coverage should be attached to the patient. The time it took to credit one invoice, attach the maxpayment limit coverage and fix the charges for the incorrect invoices took approximately *ten minutes* and there were *ten different screens* used in the Apotti system.

Figure 5 below is the second test scenario.

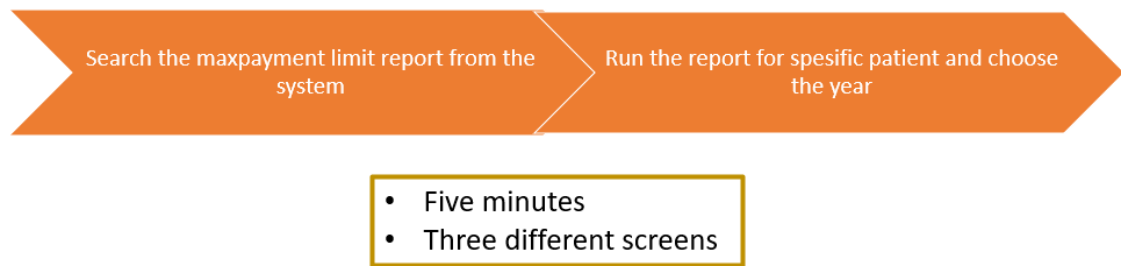


Figure 5. Test scenario 2, running the maximum payment limit report.

Figure 5 describes a situation where the maxpayment limit report is runned for a specific patient. The time it takes to run the maxpayment limit report from Apotti for a specific patient differs. It depends a lot on how many invoices the patient has had and what time of the year the report is runned. Approximately the run time is about *five minutes* and if the user runs the report and go through all the tabs inside the report, the user faces *three different screens*.

Figure 6 below is the third test scenario.

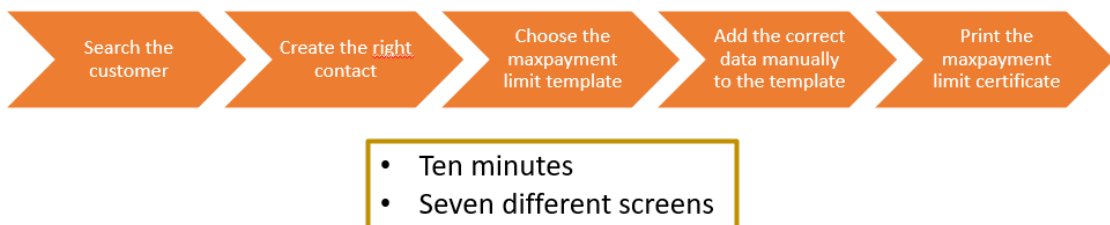


Figure 6. Test scenario 3, Maxpayment limit certificate.

Figure 6 describes a situation where the maxpayment limit certificate is printed for a customer. When printing the maxpayment limit certificate from the Apotti system the user sees *seven different screens and it takes about ten minutes*. The maxpayment limit certificate requires some manual writing inside the document. There are specific dates (when the customer has informed the customer fee unit) and which parent is the going the get the children's invoices calculated inside their accumulation. Additionally, the number of the document needs to be added manually.

### 3.2.5 Problematic Parts of the Workflow from the End User Perspective

The end users discussed here are the economy secretaries who received the questionnaire. Based on the questionnaire and old documentation, all the answers indicated the following main pain points.

*The maxpayment limit report has some problematic parts. All the charges from health and social care side should be visible on the same report. These should include the data from all the welfare areas and the hospital district that uses Apotti-system. The report should also have the data shown more widely and, in some parts, differently.*

*The report should show the invoices based on the service date and not the invoicing date. The report should show for example the temporary home care real visit dates. (Anonymous respondent C, 2023)*

*“The lawmakers state of will is that the tracking of the maxpayment limit would be in the welfare areas responsibility instead of the resident” (Anonymous respondent A, 2023)*

*The maxpayment limit workqueue is currently used only in the healthcare side of Apotti but not in the social care side. Similar tools for both social- and healthcare side would make the work more efficient. Currently the different sides do not have similar workflow due to the technical differences they have if they would act similarly the user do not need to do separate workflow inside same system.*

*Because of the workqueue the cycle time has been decreased. (Anonymous respondent B, 2023)*

*The workqueue requires improvement so that it would have all the charges that are part of the maxpayment limit accumulation. The workqueue should include social care side or that the social care side would have its own workqueue. (Anonymous respondent C, 2023)*

*The maxpayment limit certificate was done separately in the word but in Apotti system, it has been implemented as part of the workflow. It is possible to print the certificate*

straight from the system. Since the tool was new for the economy secretaries, there was not so much experience about the tool.

*Apotti should automatically add all the necessary information for the certificate. For example, maxpayment limit number and the start date (Anonymous respondent B, 2023)*

*The certificate should automatically add the information like address and information about the maxpayment limit. (Anonymous respondent C, 2023)*

*Unfortunately, we haven't had time to get to know the tool. But as my understanding the certificate has automatically more data about the patient than currently is in the word-certificate. (Anonymous respondent A, 2023)*

### 3.2.6 Demand from the Customer

Apotti received a written demand from the workflow end-user department. The customer has the ability to make demands to the Apotti Oy, where the customer can identify, specify, and request new features to the Apotti system. The demands for the workflow discussed below are from the same request.

Figure 7 below shows the areas of the workflow which this demand seeks improvement for.

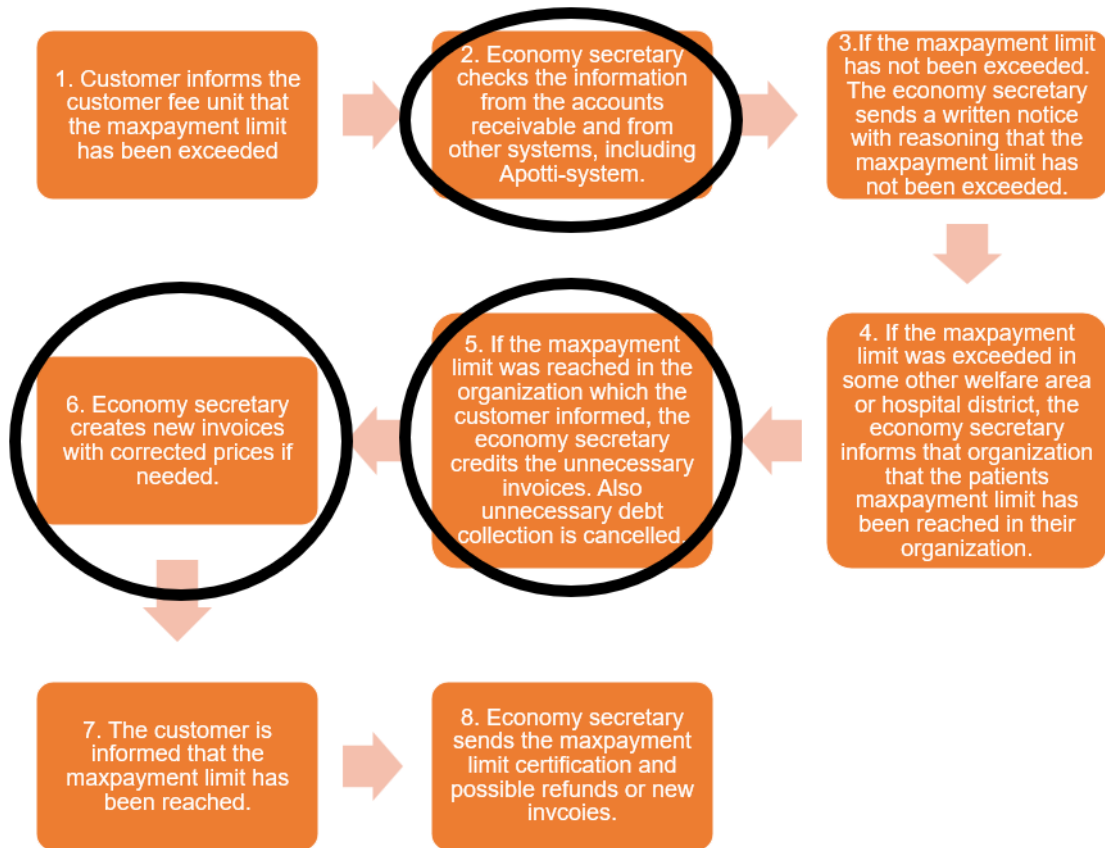


Figure 7. Parts of the process to be improved.

The demand requests development to be focused on the investigation part and the part where the economy secretary either creates new or credits invoices. These are the parts 2, 6 and seven. Table 5 summarizes what the demand requested to be developed.

Table 5. Requested to be developed.

Request	
Report	<ul style="list-style-type: none"> <li>→Health- and social care in the same report.</li> <li>→Charges which are eligible for maxpayment limit.</li> <li>→ Invoices in a chronological order.</li> </ul>
Adding other welfare area invoices	→Non-Apotti welfare areas invoices should be able to be put in Apotti
Underage patient	→Underage patient's invoices need to go straight to the parents maxpayment limit accumulation.
Automation	→Automated process that notices the user when the maxpayment limit has been reached for a patient.

First, as for *the Report*, the demand listed the need for a feature that would compile all the invoices from social- and healthcare departments that are eligible for maxpayment limit. The report should only have charges which are calculated in the maxpayment limit accumulation. These charges are based on services which were introduced in table 3. The client invoices that have gone straight to the customer need to be in a chronological order.

Second, there should also be a possibility to add invoices that have been invoiced from other welfare areas, since there has been discussion that the tracking of the maxpayment limit would be in the welfare areas responsibility in the future. There should be a possibility ready, before the possible legislation change.

Third, the underage patient's invoices need to go straight to the parent maxpayment limit accumulation.

Finally, there should also be *an automated process* of the maxpayment limit calculation. The Apotti system should automatically calculate the euros of maxpayment limit charges per patient. When the system notices that the maxpayment limit has been reached, it should go to a workqueue for a secretary to decide if the patient is eligible for the

maxpayment limit certification. From the workqueue, the end users should be able to print the certificate straight.

### 3.3 Key Findings from the Current State Analysis

Based on the analysis above, it is clear that currently the workflow has parts that could be improved. The end users have informed us that the manual work has increased since the implementation. The workflow should have more parts automated and healthcare- and social care data should be visible in the same report. In this current state analysis phase, the parts which require most of attention and development were identified as follows.

Table 6. Key improvements that need to be implemented (based on the results from CSA).

	Key findings from the CSA	Improvement area
1	Ability to add other welfare areas invoices to the system	USABILITY
2	The workqueue should include social care charges	USABILITY
3	Health- and social care data should be visible in the same report	USABILITY
4	The report should have the invoices in chronological order	USABILITY
5	The report should calculate the maximum payment limit automatically	TIME
6	The report should put the invoices based on service date	TIME
7	Underage patients' invoices should go straight to the parents' accumulation	TIME
8	Automated process that notices the user when the maximum payment limit has been reached for a patient	TIME
9	The maximum payment limit certificate should be populated automatically by all the necessary data	TIME

The current state analysis indicated the following parts that require the most improvement in Table 6.

### 3.3.1 Selected Focus Areas

The table above shows parts that are seen as important to be developed further. The current state analysis categorized these topics into the groups seen in Figure 8 below. The categorizing is done to help to understand what kind of improvements there are to be made.

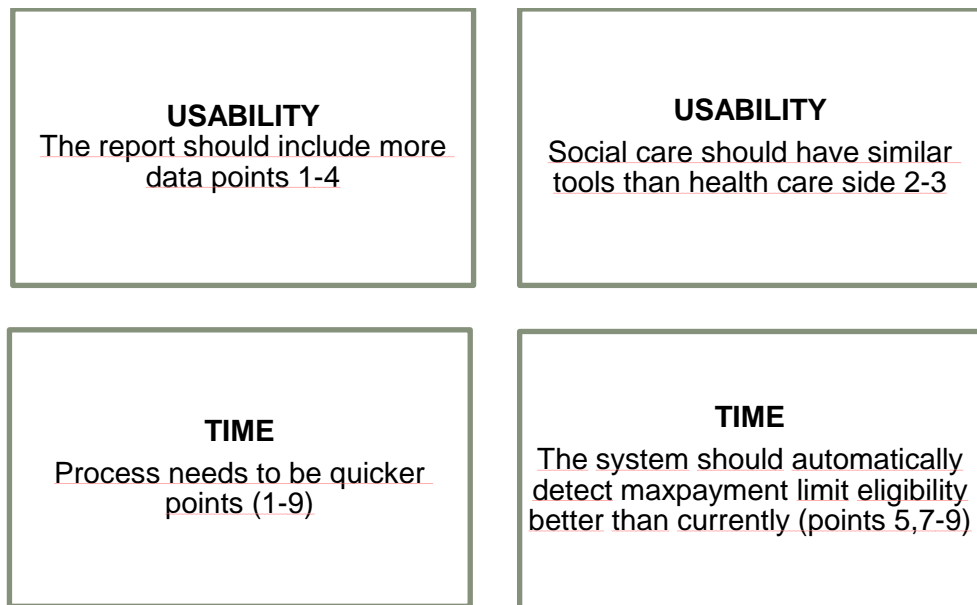


Figure 8. Four Key groups of findings from the current state analysis.

As seen in Figure 8 above, there are several aspects that need to be addressed. Firstly, in the terms of *usability*, end users express a desire to incorporate invoice data from other welfare areas that are not currently utilizing the Apotti system. It is seen crucial to improve the workflow by including the social care side, as it is currently not working as well as the health care side.

Secondly, users have also informed that certain tasks take more *time* after the Apotti implementation. In order to streamline the process more, it is important to enhance the Apotti system's automation capabilities, particularly in terms of automatically detecting eligibility for the maximum payment limit.

Based on these results, the focus areas are in the categories of *usability and time*. The current state analysis indicated that the part of the whole process done in the Apotti-system should be improved. The main improvement techniques for this plan are found



from the topics of process improvement. The process needs to be streamlined and designed so that the user is heard and by doing this, the IT system can be developed so that it serves the end-user organization.

The next section, *Existing Knowledge on Process and Workflow Improvement in IT systems*, will clarify these topics and give new information to improve the building phase of the proposal.

## 4 Existing Knowledge on Process and Workflow Improvement in IT Systems: Usability and Time

This section discusses existing knowledge in process and workflow improvement in IT systems. It is essential to understand these topics to have the necessary information when the final proposal for the maxpayment limit workflow improvement is conducted.

### 4.1 Introduction: Process & Process Improvement

Process is a set of linked actions or steps that are performed in a specific order. Each step uses one or more resource and transforms inputs into outputs. The term *process* originates from the Latin words *processus* or *processioat* and refers to the act of carrying out or performing a task, as well as the way it is carried out. (von Rosing et al. 2014,1.)

Process can be described as a sequence of linked activities or tasks that consumes one or more resources at every stage, to change inputs to outputs. These resources could be employees time, energy, money or for example infrastructure. The inputs can be material, data, or parts. The outputs can be products, information, or services. Furthermore, across time, processes do outline a specific ordering of work activities, which has a clearly defined outputs and inputs, beginning and an end and serve as the fundamental building block of all organizations. (Boutros,Cardella, 2016, 2.)

A big part of organizations success comes on how well the organization can carry out its processes. A process is considered effective, if it can efficiently and consistently achieve the desired goals or outcomes that the process was designed to produce. In other words, an effective process is one, which can consistently deliver the awaited results in an efficient and reliable manner. To illustrate a process, we can look a simplified process of ordering a meal at a restaurant. The activities in the process are as follows: (1) Customer places an order and a process is started, (2) A waiter receives and takes the order, (3) The waiter informs the kitchen about the order, (4) The chef prepares the order, (5) The waiter delivers the order to the customer (Boutros,Cardella, 2016, 2.)

Every organization has the ambition to improve its business and therefore, develop its performance of the daily work and the quality of its services. Business processes work as the operational activities, which produce, provide, and deliver its services and

products. Every organization has employees that performs activities using a lot of different resources and with multiple different levels of control. (Boutros,Cardella, 2016, 2-3.)

There are lot of processes being performed and completed daily in organizations. For example, the employer might perform same steps each day to run a report or to resolve a customer ticket. In business area we can categorize the main processes in three groups. These groups are the following: (a) Business Processes, (b) Support Processes, (c) Management Processes. *Business Processes* are the unique competencies of the enterprise, they are the main reason an organization exists. Business processes are the main activities that create value and are experienced and seen closely by the customer. These processes might include product development, support services or marketing and sales for example. *Support Processes* are the processes that support the core process backbone or value chain, the main task is to sustain the enterprise. Support processes might include accounting and finance, legal and HR and IT for example. Finally, *Management Processes* gives the direction to the enterprise, and they exist to govern the enterprises operations. One of the tasks of management processes, is to give the understanding to the employees about the strategic goals and objectives. These process categories play different roles inside the organization, but it is crucial that they are integrated and aligned together so that the performance of the entire company is maximized. (Boutros,Cardella, 2016, 5-7.)

Porter (1985) observed that to generate value for the customer involves the entire enterprise function. Michael Porter developed the value chain concept to help with the strategic analyzing. Porter claimed that processes can be categorized in two activities, either primary or support activities. After Porter, Rummler and Brache identified and formed these activities into the three processes, Business, Support and Management. (Kosleradzka, Rostek, 2021, 3-5.) Now that the function and the term process is clear the next part focuses on process improvement.

*Process improvement* is the art of making process more efficient, effective, or transparent. The topic is relevant in every area of a company, because naturally processes degrade over time for many different reasons. (Boutros,Cardella, 2016, 7) The four main goals of process improvement are: making things easier, better, faster, and cheaper. It is crucial to prioritize a quicker and more flexible response throughout the system. (Gisi, 2018, Introduction.)

An organization which prioritizes process improvement aims to identify and resolve issues proactively before they escalate and turn into crisis. Process improvement relies on a set of disciplined tools, techniques, and methods that employees can use to analyze, streamline, and optimize processes. These improvement techniques are designed so that the employee can identify inefficiencies in the company's ongoing processes. (Boutros,Cardella, 2016, 7.) However, often there is the misconception that a process improvement focuses mainly on process redesign. But in fact, the process improvement, even though the theme originates from manufacturing, the ideas encompass far more than reengineering.

Fundamentally stated, the process improvement seeks to adjust the company's basic systems, so that the changing customer needs can be met more effectively for example. Other important key benefits and objectives that are associated with process improvement includes topics like simplified regulatory compliance, improved reliability, waste avoidance, enhanced safety and security, increased accountability. (Boutros,Cardella, 2016, 7-9.) Key benefits from a structured process improvement include topics that are described in Table 7 below.

Table 7. The benefits of process improvement (Boutros,Cardella, 2016, 9).

The benefits of process improvement	
1	Consistent quality
2	Streamlined operations
3	Happier customers
4	Lower cost
5	More sales and market share
6	Improved communication
7	Higher employee morale

As seen in the table above, there is a lot of benefits in process improvement for a company. When creating a process improvement mindset, it involves several critical components that work together to deliver better results. To achieve excellence in process improvement, the employee's collaborative effort is necessary. This involves working together to combat waste and redundancy as well as preventing the growing number of errors and missteps.

In order to combat the common pitfalls, the process improvement core values serve as the guiding line to success. If the company adapts the core values, the organization has

a lot of benefits, it will be quicker to adapt to changing requirements, it will reduce risk in continuous improvement, it will ensure that the value delivered to customers is maximized and potentially discover hidden knowledge within their workforce. (Boutros,Cardella, 2016, 10-14.) The ten core values are described in Table 8 below.

Table 8. Ten core values for process improvement.

<b>Ten core values for process improvement</b>	<b>Description</b>
<b>Agility</b>	Process improvement values agile and iterative improvement, emphasizing flexible work and planning practices tailored towards incremental improvement.
<b>Quality</b>	Process improvement values quality in all aspects of the process.
<b>Leadership</b>	Process improvement values proactive and open leadership that communicates clear and compelling vision for the future.
<b>Communication</b>	Process improvement values open communication and participative decision-making throughout improvement efforts.
<b>Respect</b>	Process improvement values collegial working relationship throughout improvement activities.
<b>Discipline</b>	Process improvement values organizational discipline and maturity.
<b>Enterprise perspective</b>	Process improvement values the consideration of what is best for the organization as a whole
<b>Service orientation</b>	Process improvement values the concept that process improvement activities provide a service to companies, which involves doing what is right for the customer in question and endlessly providing expertise for their benefit.
<b>Continuous learning</b>	Process improvement values training and educating personnel, suppliers, and customers to effectively perform quality process activities.
<b>Human centered design</b>	Process improvement values human-centered design, which considers what is best for customers when designing and implementing process solutions and improvements.

The table above describes the ten core values for process improvement. Following these guidelines ensures that the company is working towards more efficient and effective processes.

This section introduced the concept of processes and their significance in achieving organizational success. This study is about the improving of the maximum payment limit workflow inside the Apotti-system which is a big part of a process.

## 4.2 Usability

An aspect of design that looks at how easy something is to use is called *usability*. (Lacey, 2017, Chapter 1, Introduction.)

### 4.2.1 User-centered Design

User-centered design (UCD) is a methodology used in IT system development which places the users at the center of the development process, this ensures, that the developed application meets their needs. The goal is to have a product that is user-friendly and effective.

*“People ignore design that ignores people.”* (Frank Chimero, 2013, Design Principles)

The process of UCD works against the assumptions that are made about the users. The method requires proof that the decisions made about the design are effective. When the UCD is done correctly, the design decisions are not based on personal preferences or whims, but instead the decisions are made by observing and actively listening the users.

There needs to be data collected and analyzed to support the decisions. This data can be collected for example by doing usability studies. When the users are observed directly, the assumptions are removed and there is a statistical proof of what is actually happening. (Lowdermilk, 2013, What Is User-Centered Design?)

*“User-centered design ensures that we examine how effective an application is in achieving its designed purpose”* (Travis Lowdermilk, 2013)

As the quote says, the user-centered design is more than just deliberating on how things look. The only focus in UCD should not be user interface (UI), even thou it plays a big part of UCD.

UCD requires the organization to ask user what they don't like in our application. This means that the organization needs to be capable to receive feedback which often means complaints. But if UCD is done and implemented correctly it saves a lot of time. If you understand the user's needs, you have the knowledge to eliminate costly mistakes. Usability can be seen as a way to avoid losing money, since fixing bugs in production and supporting users through broken workflows requires a financial commitment. (Lowdermilk, 2013, What Is User-Centered Design?)

There are many ways to study the usability, below is described questionnaires, interviews, task analysis and prototyping as four different methods. These are in table 9.

Table 9. Usability improvement methods.

Usability improvement methods	
1.	Questionnaire
2.	Interview
3.	Task analysis
4.	Prototyping

If the application is already in use, the end-users can tell that what is working and what is not, but powerful way to gain insights is by observing them.

#### 4.2.2 Questionnaire

Questionnaires have a problem that the user's perspective is skewed and subjective. If you ask from an end user that how long it takes to load your application, for some people the load time is fine and to some it is fine. (Lowdermilk, 2013, Usability Studies.)

Usability study means a measured observation of user's behavior when they use the application. It favors data, metrics, and measurements to provide assumptions. The study can be done in the user's environment, this is referred as a natural setting or an in-the-wild study. The goal is to measure the effectiveness of a feature inside the application. These measures can be time, number of errors or it can be something, that is hard to measure, like perception of value or satisfaction.

When creating a testing plan, it is crucial to know what you are looking for. There needs to be a prepared script, set of guidelines, and the right subjects to do it effectively. Table 19 describes what to include in a usability study script.

Table 10. Usability study scripts.

<b>Usability Study Script</b>	
<b>Introduction</b>	Clearly outline the study's concept and purpose
<b>Reassurance</b>	Reassure users by explaining the purpose of the study is to test the application and not any individual abilities.
<b>Testing Guidelines</b>	Guidelines help the participant to understand what is expected of them
<b>Tasks</b>	Tasks are the metrics planned to use.
<b>Conclusion</b>	Going through the conclusions with the participant is important
<b>Thanks</b>	Thank the participant and leave room for last time questions

When having a script like in the table above, it allows the questionnaire to make the practice consistent. With prepared script, the test will be same to each subject.

When doing a usability study, there are some objects that can be seen useful. These include, stopwatch, notepad, spreadsheet, camera- or audio recorder. Also choosing the right environment is important, it should have minimum distractions. (Lowdermilk 2013, Usability design.)

#### 4.2.3 Interview

Compared to surveys, interviews provide a more in-depth understanding of user needs compared to surveys, which offer a broader but potentially assumptive view. Interviews, although time-intensive and aimed at a smaller audience, capture user intent more effectively. Three main types of interviews are structures, unstructured contextual. Unstructured interviews, ideal for exploring the problem space, foster open, informal dialogues and are particularly valuable when you're unsure about what questions to ask. Structured interviews, on the other hand, prioritize consistency and rely on scripted, uniform questioning to document responses systematically. These interview methods can be strategically used at different stages of IT system development to gain valuable insights from users. (Lowdermilk, 2013, Gathering Feedback) When doing interviews,



the interviewer has to be conscious of not using leading or shallow questions, or letting personal bias and unconscious bias to impact the interview process and the data collected. Questions in this theme aim to attain the following objectives: (a) Understanding the user experience, (b) Identifying the issues and concerns, (c) Assessing expectations, and (d) Root cause analysis. These questions help to find areas where there might be opportunities to improve. (Nunnally, Farkas, 2016, Good Research Starts with Good Questions.)

#### 4.2.4 Task Analysis

Task Analysis is a method for comprehensively studying the steps involved in a particular task to enhance its execution within an application. Task analysis relies on questioning and procedural manuals. It has challenges when users might describe all aspects of a task simultaneously, potentially resulting in an unordered analysis. To address this, scenario-based questioning, where users are guided step by step through the task, can be useful. (Lowdermilk, 2013, Gathering Feedback.)

#### 4.2.5 Prototyping

Prototyping is a valuable method for application design. Prototyping not only allows early ideas to take shape but also saves time by preventing the construction of non-functional features. The versatility of prototypes enables developers to experiment with various design options, ultimately aiding in the creation of an application that aligns with user needs and expectations. Two primary categories of prototypes are distinguished: low-fidelity prototypes, which provide a basic visual representation of the design and high-fidelity prototypes, which closely mimic the final product. Early visualization through prototypes allows users to understand how the proposed application works and gives them a chance to use it and provide feedback. These prototypes also help us concentrate on making the user's experience better rather than getting bogged down by technical coding issues, promoting a user-focused design approach. (Lowdermilk, 2013, Gathering Feedback.)

### 4.3 TIME

To reduce the time used in the process, various methods are available. In this section, we explore a range of methodologies focused on optimizing time-related aspects within IT systems.

#### 4.3.1 Continuous Improvement

In today's fast paced environment, it is essential, for any organization to focus on continuous improvement to gain competitive advantage. Continuous improvement means an ongoing effort, that the organization seeks to improve its processes, products, and standards.

Continuous improvement frequently involves utilizing the Deming cycle of Plan-Do-Check-Act (PDCA). This simple method is effective, and it consists of four stages which are described in the table below. Table 9 Describes the PDCA (Plan, Do, Check, Act).

Table 11. Plan, Do, Check, Act.

<b>Plan</b>	The act of analyzing and identifying the current and desired state while studying the actions required to eliminate causes for the gap.
<b>Do</b>	Execute the action or actions, that are planned to remove obstacles, one by one. This incrementally improves toward the planned state.
<b>Check</b>	Study the results and impacts, think about other options, and decide the next actions for improvement. This phase includes studying the lessons learned.
<b>Act</b>	Follows up actions from the data obtained from the previous plan-do-check phases.

As seen in the table above, PDCA cycle is a straightforward and a simple method for improvement. The fundamental goal of continuous improvement is to reduce process variation, which is considered a process "evil": Variation can be classified as common cause or special cause, with special cause variation affecting a process in unpredictable ways, causing instability, and can be eliminated by targeting and eliminating process defects. Common cause variation affects all individual values of a process output and

can be reduced through process improvement activities focused on identifying and minimizing contributing factors, while understanding variation's influence on process performance is essential to achieving process stability and capability, which are crucial to sustainable efficiency improvements. (Gisi, 2018, Continuous Improvement.) Figure 9 shows the reducing proves variation.

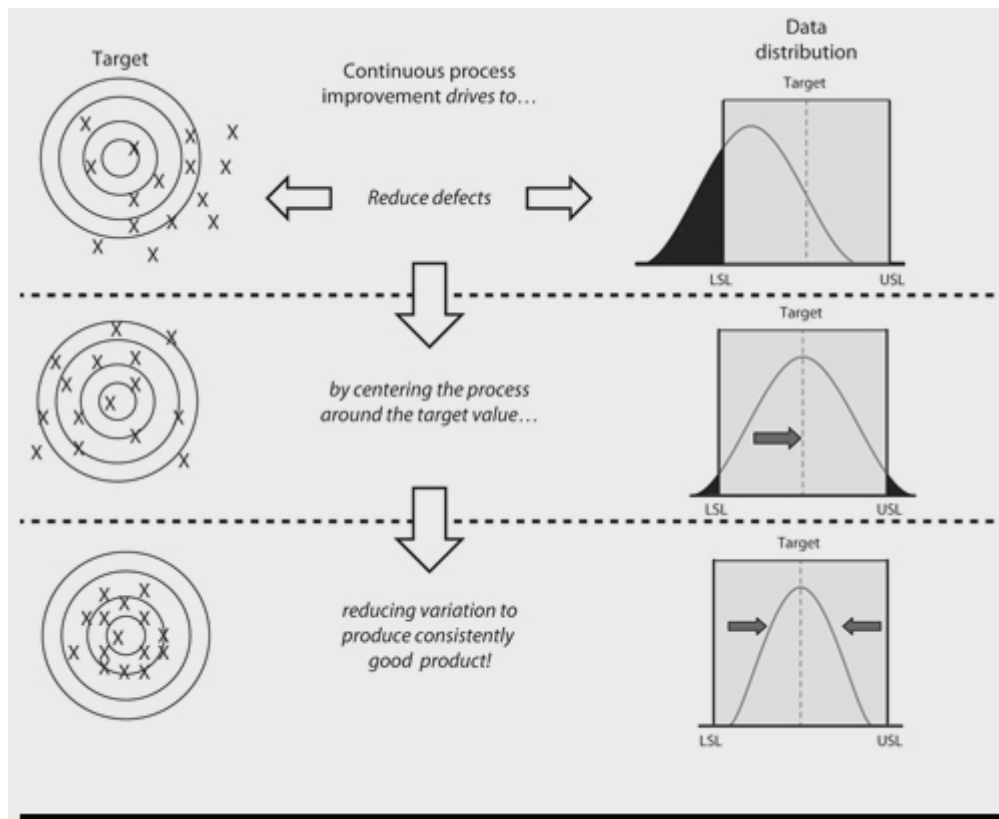


Figure 9. Reducing process variation.

As seen in the figure above the continuous process improvement drives to reduce defects by centering the process around the target value reducing variation to produce consistently excellent product. (Gisi 2018, Process Variation.)

When continuous improvement is performed, the organizations often rush to implement changes to processes without studying the current process conditions. If an organization recognizes the processes have not been performed to expectation, the organization must first fix what is broken, before making any enhancements. When the quality improvement starts it is necessary to start by identifying and eliminating defects that causes instability to the process. For a process to achieve stability, special cause variability needs to be

eliminated. Common cause variation can be tolerated in a stable process. (Gisi, 2018, Quality Improvement: Building a Foundation for Lean Efficiency Improvements.)

Over the years, several methods for improvement have been introduced, for example these include PDCA which was described previously, ISO 9000, total quality management (TQM) and Six Sigma. These improvement methods, that are focusing on eliminating process defects, have been around for the past 30-40 years. Many of these methods continue to be used for continuous improvement today, while others like lean concepts have been included or even replacing them, but the fundamental approach to process improvement remains the same: Stability and capability first, then efficiency through waste elimination and flow improvement, and sustainability through structure, accountability, and discipline. (Gisi, 2018, Quality Improvement: Building a Foundation for Lean Efficiency Improvements). Figure 11 below describes the phases of the DMAIC program.

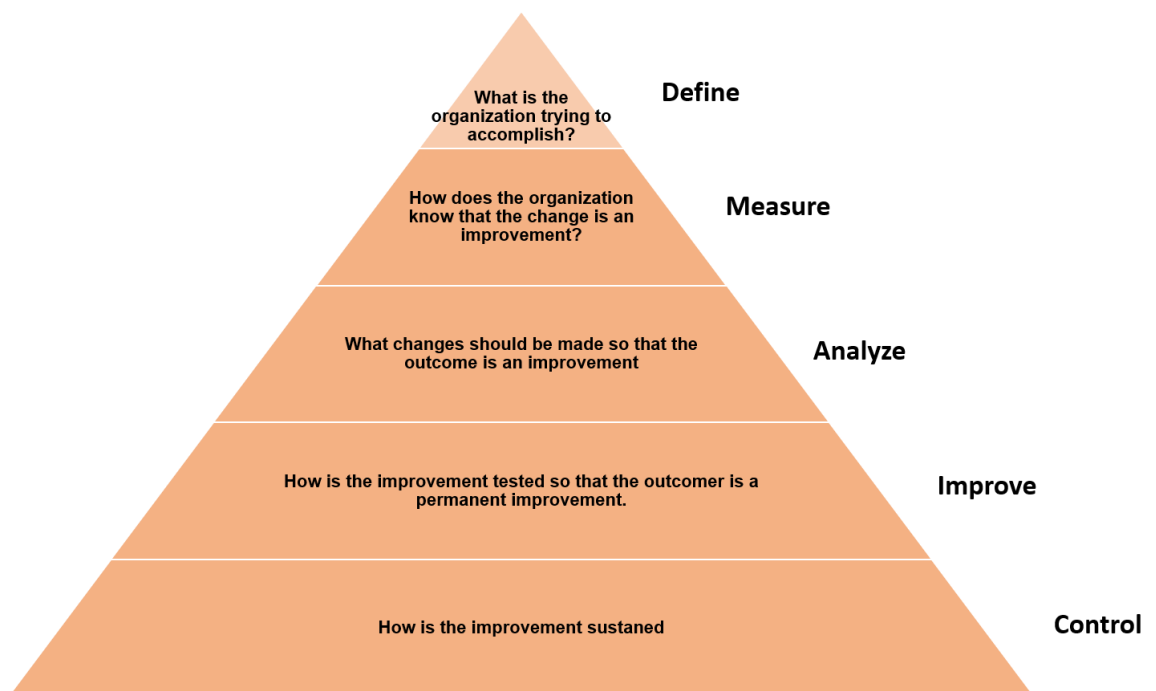


Figure 10. The phases of six sigma method (Karjalainen, Karjalainen 2020, 281).

Define step is the first step when a Six Sigma project is selected. The problem needs to be clearly defined. In this phase, it is important to identify the customers and the critical to quality characteristics (CTQ) which have the most impact on the service or product performance. (Evans, Lindsay, 2015, 47-49.)

The define step is followed by the measure step, which focuses on measuring the internal processes that affects the CTQ. This phase involves observing the processes that already exists to gain crucial insights. Also carefully listening feedback from the customers, supervisors, workers, customers, and field service employees. (Evans, Lindsay, 2015, 47-49.) It is critical, in the define step, to determine which metrics are important for the customer and the requirements from the customer needs to be translated into clear project goals. (Basu 2023, 87.)

The analyze phase focuses on why errors, defects or variation that is excessive occurs (Evans, Lindsay, 2015, 47-49). The following tools are useful in analyze phase are shown in Table 11 as tools for analysis (Basu 2023, 187-213).

Table 12. Tools for analysis.

<b>Tools for analysis</b>	
Regression analysis	Tool to establish the best-fit linear relationship between two variables
SWOT	Summary of the positive features and gaps of a process. Abbreviation comes from strengths, weaknesses, opportunities, and threats
PESTLE	Tool for assessing the effect of external contexts on majors operation or a project. Abbreviation comes from political, economic, social, technical, legal, and environmental
Five Whys	A systematic approach of asking five questions successively. The aim is to reach the root cause and get to the heart of the problem.
Interrelationship diagram	A tool to analyze and classify the cause-and-effect relationship among all critical issues of a process.

Above is a table that summarizes and describes just some of the used tools in the analyze phase. The challenge is to analyze potential causes in a trustworthy manner to gain noteworthy evidence leading to a solution. (Basu 2023, 213.)

The improve phase generates ideas to remove the root cause of the problems, there are variety of tools used in the improve phase, in the table 10 below, there are some examples of tools used.

Table 13. Tools for improvement.

Tools for improvement	
Single minute exchange of dies	A technique which is made to reduce output and quality losses due to changeovers and setups
Five S's	The tool for improving the housekeeping of an operation.
Mistake proofing	An approach that prevents errors for being converted into defects.
Brainstorming	Tool for a team to generate, efficiently and creatively a high volume of ideas of any topic. Free thinking is encouraged

The table above describes just some of the tools used in the improvement phase of the DMAIC. (Basu 2023, 215-239)

The improvement tool called “Five s’S” name originates from Japanese. The five letters “s” represents five Japanese words described below.

1. Seiri (Organization): Divide what is important and what is not.
2. Seiton (Neatness): Arrange and sort the necessary items in an orderly manner and in clearly marked space.
3. Seiso (Cleaning): Keep the workspace and surrounding area clean.
4. Seiketson (Standardization): Use laid down standards when cleaning the equipments.
5. Shitsuke (Discipline): Follow the established procedures.

The main goal of this approach is to improve the workplace organization and standardization. (Basu 2023, 223.) Brainstorming technique, that was presented in Table 12 has also some guidelines. The discussions should be centered around the process and workflow and not people. If the discussion centers around people, people’s guard will go up which will reduce their ideas of improvement. Therefore, a facilitator has to be

skilled and document all contributions without using any judgement. That means that no idea is a bad idea. The facilitator must record not what is heard but what is said. The focus should also be in solutions and not problems. Even though the root cause is found by going through the problem, still the focus should be in solving the problem. In the process of brainstorming, often innovative solutions are generated to various challenges. However, it is essential to consider deeply the practicality of the solutions. Automation has its limitations, in the process of improvement, identifying the parts that require human part, these can be tasks that require creativity, empathy or human professional judgement. (Amatayakul, 2013, Chapter 9: Identify Process Redesign Opportunities.)

The last phase of the DMAIC is control, it focuses on maintaining the improvements. Control might require using very simple tools like checklists or periodic status reviews, these tools help to follow that proper procedures are executed correctly. (Evans, Lindsay, 2015, 47-49). The tools used in the control phase are described in Table 11.

Table 14. Tools for control

<b>Tools for control</b>	
Grantt Chart	Simple tool that represents time as a bar or a line on a chart. Start and finish times are displayed by using the length of the bar as an indicator.
Activity Network Diagram	A control tool to decide and monitor the most efficient path, which is called a critical path, it also requires a realistic schedule for the completion of a project.
Radar Chart	Polar graph, that uses just one graphic the size of the gaps in the performance levels of KEY Performance Indicator.
PDCA Cycle	Plan, Do, Check, Act. Cycle that is effective both managing a programme and doing the job.

The table above describes some of the used techniques and tools in the control phase (Basu 2023, 241-251). The next part discusses the combination of Lean and Six Sigma.

#### 4.3.2 Lean Six Sigma

Six Sigma approach is the most applicable when dealing with conformance problems. When the approach evolved due time, Lean Six Sigma was invented, which has

emphasis on, besides conformance problems, efficiency problems, which are driven by cost or cycle time for example. (Evans, Lindsay, 2015, 50.) The Lean Six Sigma can be seen as a synergistic process that creates a value stream map of the process involving value add and non-value add costs. It also captures the customers voice to identify the Critical to Quality issues. (Voehl et al. 2013, Introduction to Lean Six Sigma a Methodology.)

The Lean methodologies focuses on eliminating the waste in all forms and making the flow of information smooth and efficient throughout the value chain, with the target of obtaining higher quality, lower costs, and faster customer response. The lean methodology concentrates on value-added and non-value-added activities. Value added activities add value to the product and the non-value-added activities do not add value. The methodology considers these non-value-added activities as waste. Waste was classified into seven major categories by the Toyota Motor Company, the methodology focuses on eliminating waste from all the seven categories (Evans, Lindsay, 2015, 50-56). Table 14 describes the seven categories of waste.

Table 15. Seven categories of waste.

#### **Seven categories of waste**

1. Waiting time
2. Overproduction
3. Unnecessary processing
4. Unnecessary transporting
5. Unnecessary motion
6. Production defects
7. Inventory (Evans, Lindsay, 2015, 50-56).

The Lean Six Sigma methodology adds here two more which can be seen in Table 13. (Voehl et al. 2013, Introduction to Lean Six Sigma a Methodology.)



Table 16. Two added categories of waste.

<b>Two added categories of waste</b>
1. Defects
2. Behavior

The biggest difference between Lean and Six Sigma is that Lean focuses on visible problems in processes like inventory or material flow and Six Sigma focuses on less visible problems like variation in performance. (Evans, Lindsay, 2015, 56.)

Variation describes the differences between numbers. The comprehension and study of variation is a crucial aspect of an organization that is implementing Lean Six Sigma methodologies. A key objective of a Lean Six Sigma practitioner is to minimize and manage the process variation. It is important that organization gathers and collects data over time and simultaneously measuring and studying the variable of process input variables, process outputs or process methods. Process lead time is a common process output variable in the Lean Six Sigma methodology. Customers are often sensitive to the amount of time it takes for an organization to add value for them. Understanding and controlling the process variables has many benefits. It allows the organization to improve the entire supply chain, it also allows the organization to uncover important insights concerning the interactions between processing equipment and the material. It also provides a foundation for assessing the organizations performance output behavior which is a critical for customer satisfaction. All our outputs can be seen as key performance indicators and subject to variation. (Voehl et al. 2013, Waste Identification)

Lean Six Sigma organization needs to decide what is a waste and what is not, this is done by defining the value-added and non-value added, and non-value-added but necessary activities. The waste creeps into process usually over time. It is important for an organization to regularly question and re-evaluate the way things are done.

Example for waste in automation could be a situation where senior managers or owners want to see expensive equipment running, and not sitting idle. This misuse in automation can cause overproduction. Another example in product complexity could be that a complex product that is formed and build in a rush and implemented into use before the sufficient design has been completed. Defects are caused for example in a situation where customer needs are not understood, product design is poor, or process control is

weak. To build a defect-free product, establishing comprehensive customer requirements is seen essential. Often the developers think that they know what the customer wants, what is important to the end user, or the developers make assumptions about how the end user will use the product. Any factor that hinders the product from meeting the customers' requirements exactly is typically something that can be defined as a defect. Defects can be identified by following a set of questions that forces the developer to observe the product deeply. (Voehl et al. 2013, Waste Identification.)

It is important for an organization to learn to see the variation and waste. It can be as a critical first step for improving productivity quality and profitability. The process either adds value or waste to creation of services or a product. To eliminate waste or variation, it is important to understand exactly what waste is and where it lies, and to clearly measure, view and limit variation. (Voehl et al. 2013, Waste Identification.)

Automation can occur at various levels, primarily categorized by whether a process is human-controlled, computer controlled or fully automated. Automation is motivated by specific reasons described in Table 20. (Ruecker, 2021, The Journey to Introduce Process Automation.)

Table 17. Motivations to automate.

Motivations to automate		
1.	High number of repetitions	Tasks involving a high volume of repetitions are prime candidates for automation due to the efficiency gains it offers
2.	Standardization	Automation thrives in environments where processes are structured and predictable
3.	Compliance conformance	In certain industries or specific workflows, strict regulations demand auditability and adherence to documented procedures in a consistent and reviewable manner. Automation ensures adherence to compliance standards and provides immediate access to high-quality, pertinent data.
4.	Information richness	Automation is particularly suited for processes that involve a substantial amount of digitized information. It streamlines the handling of data-rich tasks and enhances overall efficiency.

5.	Need for quality	Automation is instrumental in processes where maintaining consistent quality is imperative. For example, when committing to specific delivery timelines for customer orders, automated processes make it easier to consistently meet these expectations.
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As seen in Table 22, there are many motivations to implement automation. Automation is important when process time is repetitive, time-consuming and resource intensive.

The next element in the existing knowledge part of this thesis is about improvement methods in IT systems. Since the same methods of improving IT systems are used in software development, the next part will focus on lean IT system development, with the focus on the same tools which are used in lean software development.

#### 4.3.3 Lean Software Development Methods Applicable in IT systems

Development is the process of turning ideas into products, and there are two approaches or schools of thoughts, they can be called deterministic and empirical. The deterministic approach begins with a complete product definition, while the empirical approach starts with a high-level concept and uses feedback loops to optimize its interpretation. (Poppendieck, Poppendieck, 2007, Chapter 2. Principles.)

Lean emphasizes seeing the whole through the eyes of the customer and not focusing on seeing it through the eyes of the developer. Organization which is lean optimizes the whole value stream, from receiving and order through to the software implementation. (Bell, Orzen, 2010, 170.)

Table 18. Seven wastes of software development.

The Seven Wastes of Manufacturing	The Seven Wastes of Software Development
Inventory	Partially Done Work
Extra Processing	Extra Processing
Overproduction	Extra Features
Transportation	Task Switching
Waiting	Waiting
Motion	Motion
Defects	Defects

Table 16 shows Seven Wastes of Software Development (Poppendieck, Poppendieck, 2003, Eliminate Waste). As learned from the earlier section, lean thinking focuses on eliminating waste. Learning to see waste in software development is crucial. The seven wastes of manufacturing transferred to the seven wastes in software development differs from some parts, as seen in the table below (Poppendieck, Poppendieck, 2003, Eliminate Waste).

#### 4.3.4 The Seven Principles of Lean

This section summarizes the seven principles of software development. Principles can be seen as underlying truths which don't change over time and space.

##### 4.3.4.1 Principle 1: Eliminate waste

Similarly, as in manufacturing, in software development it is important to recognize waste first. The first step to do, is to develop a keen sense of what value is. In software development, the customer does not often know what they want. For the developer it is hard to have a deep understanding what customer will truly value after they have started using the software. Once a customer sees the software in use their idea of what they actually want can often shift. (Poppendieck, Poppendieck, 2007, Chapter 2. Principles.)

Once the organization has gained the understanding of value, the next phase is to develop the skill to really see waste. Waste, looked from the customer point of view, is anything that the company does that does not give value to the customer, and it is not necessary to running the organization. The inventory for example is in software development called partially done work. Partially done work potentially ties money, grows obsolete, hides quality problem and it gets lost. (Poppendieck, Poppendieck, 2007, Chapter 2. Principles.)

Often seen as the biggest form and source of waste in software development is extra features. In the book implementing lean software Mary and Thomas Poppendieck stated that only about 20 percent of the features and functions in typical custom software are used regularly. Two thirds of the functions and features developed remains unused or rarely used. These features are often features that were not needed in the first place at all. The cost side of development extra features is huge, they also add unnecessary

complexity to the code, which means, that the maintaining becomes more expensive. (Poppendieck, Poppendieck, 2007, Chapter 2. Principles.)

In the book Lean IT, the waste was described similarly that only about 20 percent of the functions and features were used regularly and around two-thirds are rarely used. The book stated that IT professionals generally share the thought that at least 50 percent of the capabilities of software are not adding value to the business process they support. Extra features requires developers time, which could otherwise be directed toward value-adding work and activity. (Bell, Orzen, 2010 171-172.)

There is a myth, that early specification reduces waste. The specification with customer often goes as follows: The software developer company asks the customer about a list of everything they want the software to perform. Then the developer company will write it down and ask the customer to sign it. After the signature the customer needs to go through a slow change management process, to get any changes to the system. With this information, the customer then throws into the specification document everything. (Poppendieck, Poppendieck, 2007, Chapter 2. Principles.)

#### 4.3.4.2 Principle 2: Build Quality In

The goal in the software development practice is to build quality into the code from the start, not to test it later. It takes a highly disciplined organization to make sure that the focus is not to put the defects in the tracking system but instead avoid creating defects in the first place.

There are two kinds of inspection: inspection after defect occur and inspection to prevent defect. The organization might think that since a defect is in a defect tracking system queue, it is ok. But in lean paradigm, queues are in fact are a collection points for waste. The goal is to not have defects in the queue, but the ultimate goal is to eliminate the defect tracking queue altogether. In software development it is seen important to fix the defects immediately when they occur and not to record them in the defect tracking system. This is done by running tests often to see that defects have not been occurred. If the test do not pass, the developers do not move forward with the coding before the problem is fixed or the bad code is backed out. (Poppendieck, Poppendieck, 2007, Chapter 2. Principles.)

#### 4.3.4.3 Principle 3: Create Knowledge

Companies which have gained long-term excellence in product development share a common trait: The companies do generate new knowledge through experimentation, disciplined in nature, and codify that knowledge concisely to make it accessible to the larger organization. A professor in Harvard Business School Alan MacCormack studied how organizations learn. He found out about software development practices that the ones that learned new insights from the market during the development created a better product than the other ones. MacCormack identified four practices which lead to successful software development which are described in Table 15 (Poppendieck, Poppendieck, 2007, Chapter 2. Principles.).

Table 19. Four practices of successful software development.

<b>Four Practices of Successful Software Development</b>
1. Early release of minimum feature set to customers for evaluation and feedback
2. Daily builds and rapid feedback from integration tests
3. Leader/or a team which has the experience and instincts to make great decisions
4. A modular architecture that supports the ability to easily add new features

It is important that the company has obtained a development process which encourages learning systematically throughout the development cycle. There is a myth that predictions create predictability. Software development has a reputation for being unpredictable. Therefore, it is crucial that the company response correctly to change when the predictions turn out to be inaccurate. The most predictable results are produced by making decisions based on facts, rather than forecasts. (Poppendieck, Poppendieck, 2007, Chapter 2. Principles.)

#### 4.3.4.4 Principle 4: Defer Commitment

It is important to make the important decisions in software development process when you have enough necessary information as possible, this is done by waiting as long as possible before doing the decision. Irreversible decisions should be scheduled for the last responsible moment, which is the last chance to make the decision before it is too late.

The decisions should be tried to make so that they can be reversed, so they can be easily changed if change is needed. When making early features, it is important to avoid making decisions which lock in a critical design which would be difficult to change. A software system should or does not need to be completely flexible, but there needs to be an option to be in the points where change likely will occur. Great software firms leave options open so that irreversible decisions can be made as late as possible. (Poppendieck, Poppendieck, 2007, Chapter 2. Principles.)

#### 4.3.4.5 Principle 5: Deliver Fast

Delivering fast eliminates a huge amount of waste and waste costs money as learned in the earlier parts. If a company is fast at delivering, it has the possibility to experiment with the customers by trying new ideas and learning what works.

By delivering fast there is not time to change the specifications. In the software development industry, there has been a thought that in order to get top quality the company needs to slow down and be careful. Google for example is a company that has delivered software very fast and with high quality. In order to get fast delivered software the company needs engaged thinking people which can be trusted to have the capability to make great decisions and help each other out. Companies which are fast-moving, structures their work so that the employers doing the work know what to do without being told and they have the ability to solve problems and adapt to changes without having a permission. (Poppendieck, Poppendieck, 2007, Chapter 2. Principles.)

Achieving high quality can be done by two ways. Either the company slows down and becomes careful, or the company develop people who continually build quality straight into their product, develops the capability to reliably respond to the customers faster than the company's competitors and who continually improve their processes. (Poppendieck, Poppendieck, 2007, Chapter 2. Principles.)

Requirement definition has a huge part in delivering fast. Voice of the customer is essential element when performing Lean software development since the customers definition of what is value guides all activity. Finding the root cause is important and to not only address symptoms by apparent solution. In the early phase the customer might

not initially know what they need. They might have incomplete understanding of the situation, or they might lean to the old mental model learned from earlier systems. (Bell, Orzen, 2010 179-181.)

#### 4.3.4.6 Principle 6: Respect People

This principle can be described with three cornerstones in Table 20.

Table 20. Three points for respect people -principle.

<b>Three points for Respect People -principle</b>
1. Entrepreneurial Leader: Successful products can usually be traced to excellent leader. People like to work with successful products. A company, which respects its employees develops good leaders. (Poppendieck, Poppendieck, 2007, Chapter 2. Principles)
2. Expert Technical Workforce: Company that wants to maintain and gain a competitive advantage in a specific area has to develop technical expertise in that chosen area. Companies that buy the needed expertise will soon find out that their competitors can buy them as well. Companies that can be seen wise make sure that technical expertise is nurtured, and teams have the needed experts to accomplish the goals that are set. (Poppendieck, Poppendieck, 2007, Chapter 2. Principles)
3. Responsibility-Based Control and planning: Teams should have reasonable goals, general plans and the teams should be trusted to self-organize to meet the goals. Respect means that instead of telling people what and how to do the work, the company develop a reflexive organization where people solve problems themselves. (Poppendieck, Poppendieck, 2007, Chapter 2. Principles)

As seen, the three points are straightforward, leader should be entrepreneurial, technical workforce should be experts and control and planning should be responsibility based. (Poppendieck, Poppendieck, 2007, Chapter 2. Principles.)

#### 4.3.4.7 Principle 7: Optimize the Whole

The whole value stream needs to be optimized. A lean organization does this from the time it receives an order to address a customer demand until software is implemented, and the demand is satisfied. If a company decides to focus on optimizing just a part of the entire value stream, it can be almost guaranteed that the overall value stream suffers. (Poppendieck, Poppendieck, 2007, Chapter 2. Principles.)



#### 4.4 Conceptual Framework of This Thesis

The conceptual framework is presented in Figure 11. These main themes presented in the conceptual framework, when put together, will guide the action of making the improvement document. Figure 11 shows the Conceptual framework for the workflow improvement.

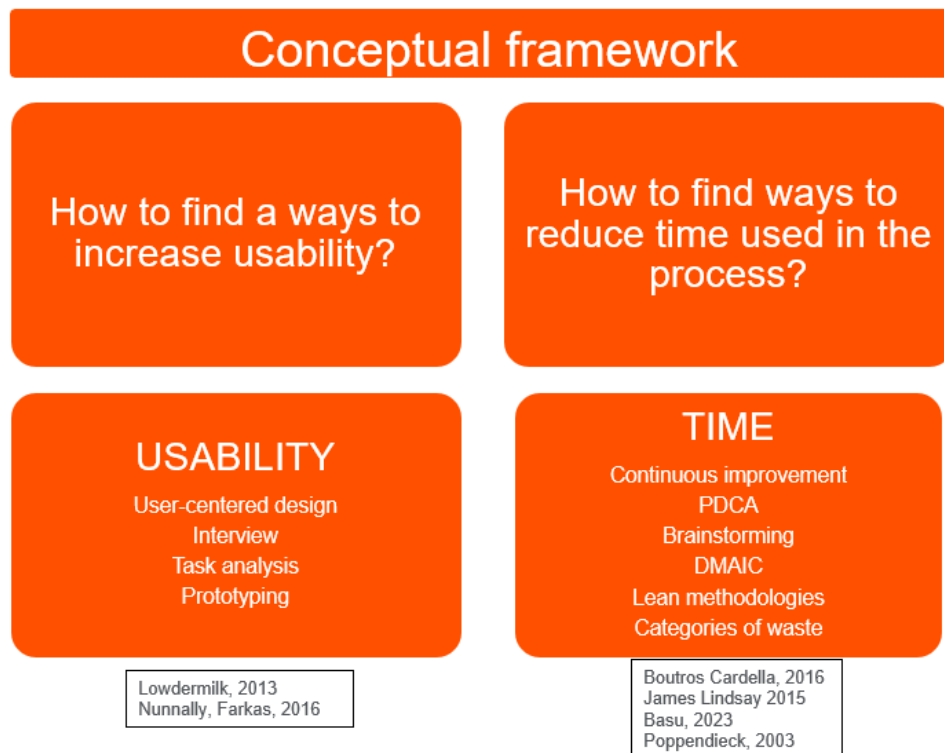


Figure 11. Conceptual framework for the workflow improvement.

The figure shows the two main categories, under the chosen themes, time and usability; while the tools and techniques were chosen to be part of the improvement act. The workflow improvement requires these parts to be used, so that to tackle the pain points the workflow.

*Usability* of the tools in any process requires development. To develop comprehensive solutions, user centric design, brainstorming, Interview, task analysis, and prototyping techniques are typically used.

*Time* was found to be one of the main problems in any process, that can be tackled by various methods like continuous improvement, PDCA, brainstorming, DMAIC, Lean methodologies, Categories of waste are guiding the plan creation. These methods help to find the parts which can be taken out, which parts can be made more streamlined.

The next section, *Building the Maxpayment Limit Improvement Document* will utilize these suggestions for building the proposal, which is a maxpayment limit improvement plan. The existing knowledge will guide the improvement process by giving the necessary direction to make the maximum payment limit workflow work in a more efficient way.

## **5 Building the Development Plan with the Specification for the Improvements for the Workflow on How to Proceed During the Years 2023/2024 (with the focus on: Usability and Time**

This section merges the last two sections, the current state analysis, and the existing knowledge, in order to build *the Maxpayment Limit Plan with Specifications for Improvement* based on internal co-creation and discussions (which make Data collection 2).

### **5.1 Overview of the Proposal Building Stage**

The Proposal is built on three inputs. First, the Current state analysis phase showed that the workflow takes currently too much time, has usability issues (e.g. the health- and social care data should be visible in the same report and there should be possibility to add charges from other welfare areas with the reporting purpose), as well as it lack automation. The Maxpayment Limit Workflow Plan with specifications for improvement will focus to resolve these issues.

Second, the Existing Knowledge stage described the necessary steps to take when a process improvement focuses on improving usability and time. The stage addressed the tools and methods which are important in this context.

Third, the Proposal involved co-creating and collaboration from the key stakeholders, application coordinators and end-user representatives. The co-creation of the Proposal was done as follows:

Firstly, the initial improvement document was formed with the Application Coordinators. This was the first phase of data collection 2. A lot of data was revised from the current state analysis which voiced the end users hopes for the improvements. This first rough version was important to be made, so that the changes could be discussed with the end users and then co-create the final document.

Secondly, the data was collected to verify the main changes planned with the end users, this was done inside a workshop where was a demo of the maxpayment certification and specifications for the maxpayment limit report.

Thirdly, there was workshop inside Apotti with two application coordinators to go through the document, and update it based on the end user input. Figure 13 shows the three workshops and their dates.

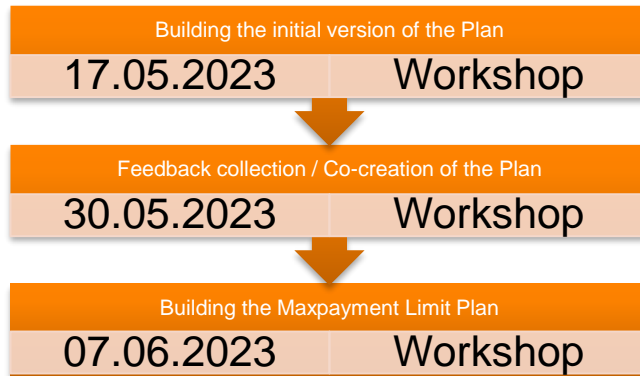


Figure 12. Building the improvement plan.

As seen in Figure 13, there were three steps to build the proposal. All the necessary stakeholders were heard during the process, the application coordinators, the end user organization representatives. The workshops conducted were documented in the field notes. All input from the stakeholders in this proposal building stage was taken into thoughtful consideration to create the best possible solution for the workflow.

## 5.2 Findings from Data 2

The first version of the improvement document was conducted with the necessary stakeholders inside Apotti, they were the application coordinators, who can configure the system. The main idea was to first investigate if the problem can be fixed inside the Apotti-system, then to find the best way to make the workflow as user friendly and streamlined as possible. In the workshop the solutions were generated, by going through the themes of usability and time. The findings from the current state analysis were addressed and each of them analyzed by using the methods discussed in the conceptual framework. Table 6 showed the key findings from the current state analysis and Table 21 below shows the CSA findings as addressed in the workshop meeting.

Table 21. Key findings and solutions.

	Key findings from the CSA	Improvement area	Is it possible to do inside Apotti?	Best practises used
1	Ability to add other welfare areas invoices to the system	USABILITY	Yes a tool inside the Apotti system can be utilized.	Task analysis / Prototyping
2	The workqueue should include social care charges	USABILITY	Currently it cannot be done, since workqueue tool does not work similarly in the social care side.	User-centered design
3	Health- and social care data should be visible in the same report	USABILITY	Yes it is possible to do. It requires new report and utilizing	User centered design
4	The report should have the invoices in chronological order	USABILITY	Yes it is possible to do.	User centered design
5	The report should calculate the maximum payment limit automatically	TIME	Yes in the new report it is possible to do.	Waste reduction
6	The report should put the invoices based on service date	TIME	Yes in the new report it is possible to do.	Lean methodologies
7	Underage patients' invoices should go straight to the parents' accumulation	TIME	Has to be discussed with clients	PDCA
8	Automated process that notices the user when the maximum payment limit has been reached for a patient	TIME	It is possible to do in the future.	Brainstorming
9	The maximum payment limit certificate should be populated automatically by all the necessary data	TIME	The maxpayment limit accumulation date cannot be added automatically.	Brainstorming

The document was stripped down from any technical jargon due to the company policies and to make it clear for the possible readers. The technical side of the improvements were left out of the document presented here in this thesis due to the same policies. Main parts of the workflow were chosen to be the report, certification, workqueue and the possibility to add other welfare areas invoices. These were found to be the best parts to focus on when improving usability and time. Prototypes were made to test the ability to add other welfare areas invoices to the system and to have a more detailed maximum payment limit certificate.

A Preliminary plan was made to address all these areas to guide the co-creation meeting with the end user. The plans for changes for the report, certification and workqueue were presented to end-users. Different parts of the workflow were demoed from the system by an application coordinator to help the discussion and co-creation. After the brainstorming and discussion, the feedback from the end-user organization was positive.

*“The planned changes are looking promising”* (Anonymous end-user A, 2023)

With the information gathered from these two workshops a third one was conducted to update and finalize the maximum payment limit improvement document. The input from workshop two can be seen in Table 22.

Table 22. Input from end-user organization.

	Key findings from the CSA	Improvement area	Input from the end-user organization	Best practices used
1	Ability to add other welfare areas invoices to the system	USABILITY	The invoice can never be invoiced from Apotti	Prototyping / Interview
2	The workqueue should include social care charges	USABILITY	It should atleast currently detect the patients which have reached the limit	User-centered design
3	Health- and social care data should be visible in the same report	USABILITY	There should also be possibility to modify the parameters more effectively. Summary to easily identify	User-centered design
4	The report should have the invoices in chronological order	USABILITY	There should be a cumulative follow for the euro amount	User-centered design
5	The report should calculate the maximum payment limit automatically	TIME	There should be possibility to run every resident who has reached the limit	Waste reduction
6	The report should put the invoices based on service date	TIME	Yes	
7	Underage patients' invoices should go straight to the parents' accumulation	TIME	It is not possible to automatically know to which parents accumulation it should go	Brainstorming
8	Automated process that notices the user when the maximum payment limit has been reached for a patient	TIME	The patients should automatically come to the workqueue when the limit is reached.	Interview, Brainstorming
9	The maximum payment limit certificate should be populated automatically by all the necessary data	TIME	It should be possible to access the certification from multiple locations in the software. There should also be	Prototyping / Interview

Then the document was updated with the new information gathered from Application Coordinators and end-users. Stakeholders gave important insights as an expert of the workflow and the software itself. The CSA also identified some parts to be improved and the data collection done after the existing knowledge revealed new parts. These parts were found from the workshops done in the data collection round two. The main focus is the four tools inside Apotti-system. These tools are report, Certification, Workqueue and the possibility to add other welfare area invoices. These can be seen in Table 23 with the input.

Table 23. The four improved tools inside the Apotti-system.

**Input****Report**

Health- and social care data in the same report  
 Cumulative follow for the euro amount  
 Possibility to modify the parameters more effectively  
 Possibility to export report to excel  
 Possibility to run every resident who has reached the limit  
 Summary to easily identify patients

**Certification**

Possibility to access the action from multiple locations  
 Possibility to print other documents related to maxpayment limit  
 Possibility to print with different languages

**Workqueue**

Possibility to detect patients who has already reached the limit

**Other welfare area invoices reporting**

Possibility to add other welfare area invoices  
 Charge batch entry tool to add dummy charges for reporting purposes

These four parts: *reports*, *certification*, *workqueue* and *other welfare area invoices reporting* are the key development parts of the improvement document. The three main findings for the pain points from CSA were time, usability, and automation. After these changes presented in the table 19 are made to the system the workflow will be quicker and more user friendly, the benefits are described shortly in Table 23.

### 5.3 The Maximum Payment Limit Improvement Plan

The proposal draft included all the areas to be improved. Below is described all the elements in the document. The areas of improvements include report, certification, adding non-Apotti invoices and the workqueue.

#### 5.3.1 Maximum Payment Limit Report (Usability / Time)

The report will include both health- and social care data from the system, they will be listed by the service date. Accumulation calculator will follow the charge. With this report the user is able to see the exact date when the maxpayment limit is reached. The Parameters for the report are planned to be as followed:

1. Year
2. Patient (or multiple chosen patients)/ All
3. Maxpayment limit has went over: (Yes or NO)
4. Maxpayment added already: Yes or No
5. Service area: All or Specific.

When the report is runned with a specific patient:

- Health- and social care charges in the same report on service date order. Including price, has they went to billing system, etc.
- Cumulative follow, that adds the charges euro amounts. This allows the end users to follow the maxpayment limit with daily accuracy.
- The report can be exported to excel for further calculations.

When the report is runned with all patients:

- Summary with name (Social security number) and euro amount.

### 5.3.2 Maxpayment Limit Certification (Usability)

Other documents from the area of maxpayment limit will be added to the workflow. These are sent to Apotti from the end-user. These include documents with different languages and to address a situation where the maxpayment limit is not reached. These documents need to be gathered from all the Apotti-using welfare areas. Header and footer information differs. All the possible patient information populated automatically to the document.



### 5.3.3 Adding non-Apotti Welfare Areas Invoices (Usability)

A charge batch entry tool will be used when non-Apotti using welfare area invoices are added to Apotti. This workflow will use a dummy charge for reporting purposes since these charges are not going to be billed from Apotti system. The reason is only to make them visible in the maxpayment limit report to meet the possible legislation changes in the accumulation following responsibility. Figure 13 below shows the workflow steps.

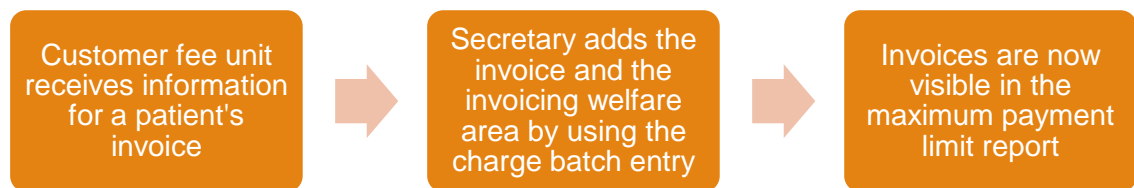


Figure 13. Adding non-Apotti welfare areas invoices.

### 5.3.4 Workqueue (Time)

The possibility for importing data from the report will be investigated, configured and implemented latest next year. Patients who have reach the maxpayment limit will be automatically detected with the data from the report and the information is imported to the system to mark them to swim to the workqueue. Figure 15 shows how the workqueue function is planned to work.

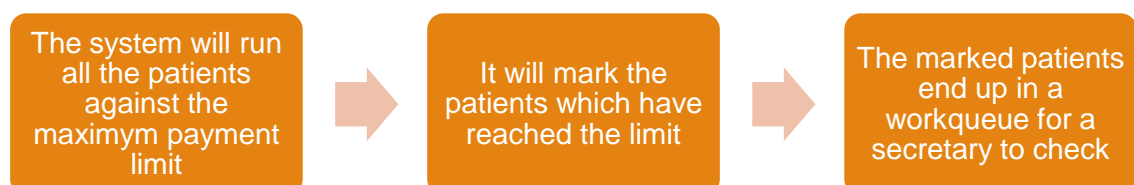


Figure 14. Workqueue function.

#### 5.4 Summary of the Plan

The proposal focuses on making the process more efficient, as the CSA pointed. The existing knowledge phase introduced various ways to improve process and what to focus on in IT-system development.

The main areas of improvement were discovered from the CSA, especially from the questionnaire and demand where the end user's needs were introduced throughout. Then in the later phases CSA discoveries were investigated deeper and with the co-creation of the end-user organization all the necessary parts were found, and improvement ideas were generated and planned. Table 24 below, shows the developed tools inside the Apotti-system. It shows how the system use to work and how it is planned to work.

Table 24. Improved areas, how they were and how they will be.

<b>Maximum payment limit report</b>	
<b>How it was</b>	<b>How it will be</b>
Health- and social care in different reports	Health and social care in the same report
Year and patient as only parameters	Possibility to see the exact date when the maxpayment limit is reached
List of maximum payment limit charges for the sepcific patient	Option to choose multiple patients
Ordered by the invoicing date	Option to choose if the report will show patients that have or have not reached the limit
	Is the maximum payment limit already added to the patient
	Which service area to choose
	Summary levels with name, social security number and the accumulated euro amount
<b>Maximum payment limit certification</b>	
<b>How it was</b>	<b>How it will be</b>
Limited possibility to print the certification	Possibility to print the maximum payment limit certification
	All the maximum payment limit documents from the Apotti using welfare areas
	Different language versions
	Patient information populated automatically
<b>Adding non-Apotti welfare areas invoices</b>	
<b>How it was</b>	<b>How it will be</b>
No possibility to add other welfare area invoices	Possibility to add other welfare area invoices by using a tool called charge batch entry
	Dummy charge for every welfare area
	Charges are not possible to invoice from Apotti
	Only to be visible in reporting
<b>Workqueue</b>	
<b>How it was</b>	<b>How it will be</b>
<i>Organization A</i>	Automatically add patients which have reached the accumulation from the maximum payment limit eligible charges
Only patients that were inpatient and had continuous 17 day stay	
<i>Organization B</i>	
Patients that has charges with more amount than +600eur	

The table below shows, which parts of the process these changes will affect.

Table 25. Parts of the process that will be improved.

Process step	Apotti-tool
1. Customer informs the customer fee unit that the maxpayment limit has been exceeded	
2. Economy secretary checks the information from the accounts receivable and from other systems, including Apotti-system.	Maximum payment limit report. Workqueue. Charge batch entry.
3. If the maxpayment limit has not been exceeded, the economy secretary send a written notice with the reasoning that the maxpayment limit has not been exceeded.	Maximum payment limit certificate
4. If the maxpayment limit was exceeded in some other welfare area or hospital district, the economy secretary informs that organization that the patients maxpayment limit has been reached in their organization.	
5. If the macpayment limit was reached in the organization which the customer informed, the economy secretary credits the unnecessary invoices. Also unnecessary debt collection is cancelled.	Maximum payment limit report. Workqueue
6. Economy secretary creates new invoices with corrected prices if needed.	Maximum payment limit report.
7. The customer is informed that the maxpayment limit has been reached	Maximum payment limit certificate
8. Economy secretary sends the maxpayment limit certification and possible refunds or new invoices.	Maximum payment limit certificate

The table above shows that the process will be improved in more parts than the current state analysis forecasted in Figure 7. The process parts that are to be improved are marked in red, the improvements will affect almost all parts of the process.

Table 26 shows the action plan for the necessary changes to make the workflow less time consuming and to have better usability.

Table 26. Action plan for the improved tools.

Action Plan			
Apotti tool	Responsible Team	Start	End
Maximum Payment Limit Report (Usability / TIME)	Reporting team, Hospital Billing Team,	8 / 23	30 / 11
Maximum Payment Limit Certification (Usability)	Hospital Billing Team, Communications	8 / 23	30 / 11
Adding non-Apotti welfare areas invoices (Charge Batch Entry) (Usability)	Hospital Billing Team	8 / 23	30 / 11
Workqueue (TIME)	Hospital Billing team	8 / 23	30 / 11

The next section *Validation of the Proposal* is about the validation process of the maxpayment limit improvement document.

## 6 Validation of the Proposed Plan

The validation of the proposed improved document is presented in this section. This section contains the feedback from the product manager.

### 6.1 Overview of the Validation Stage

Lot of validation was done during the building phase of the proposal. The end-user organizations representatives and application coordinators were heard during the building phase. During the build phase there was discussion with the stakeholders who gave their output on the improvement document as discussed in the earlier section.

Validation was done with the product manager, and it was done by going through the document and gaining insights and feedback from the product manager. The meeting was conducted in teams and the answers were documented in the field notes. The document did not require any more changes from the validation phase.

#### 6.1.1 Validation of the Document

The Product Manager of hospital billing in Apotti was chosen to validate the improvement document. The validation happened on a Microsoft teams meeting, the interview is documented in Appendix F.

The document was read during the meeting and the product manager commented the document. Overall, the document was understandable and comprehensive. The document can be viewed in Appendix G.

*“Yes, the document is understandable and comprehensive”* – Product Manager

The main goal of this study was to make a plan for improving the maximum payment limit workflow. In the meeting, the demand from the customer and the current state analysis were investigated and compared to the planned improvements.

The question for this topic was: Based on the demand from customer, does this plan answer to the needs and does it answer to the other requirements we have gathered?

*“Yes, the improvement document does answer. It also includes future enhancements, topping the original requests” -Product Manager*

The planned schedule seemed to be realistic, most important changes are planned to happen during 2023 and future enhancements in 2024.

*“Schedule is realistic and acceptable” -Product Manager*

The Product Manager did add that the improved parts could be described more in detail in the document. But in this thesis the technical parts cannot be described in more detail due to the company policies.

*“The improved parts could be described maybe more in detail” -Product Manager*

Finally, the Product Manager accepted the document.

*“Yes, the document is approved” – Product Manager*

The accepted final proposal can be read in Appendix G. In the proposal the technical parts are not visible which were addressed to the necessary teams due to the company policies.

## 7 Conclusions

This section of the thesis contains the summary of the study.

### 7.1 Executive Summary

The Apotti-system is used in various administrative works. These include the maximum payment limit workflow. The objective of this study was to propose a plan on how to proceed with the necessary build in 2023 and 2024 to improve the workflow. The outcome of this thesis is a development plan document that contains the plan.

Firstly, the current situation of the workflow was analyzed to gain the understanding of the weaknesses the workflow currently has. The data was collected from workshop, demand from customer, internal documents, interview, and questionnaire. Secondly, the study had a chapter about the existing knowledge in process and workflow Improvement in software development, where the best practices were analyzed. Thirdly, the improvement plan was conducted in a document form. Finally, the document was validated and approved by the hospital billing product manager. The whole process took approximately five months.

The data used in this study was collected in three rounds. The first round of data collection was about the current state of the workflow of maximum payment limit inside the Apotti-system. The second round of data collection was about building the proposal. The last one was about validating the document.

The result of this study is the maximum payment limit improvement plan, which describes the improved parts of the Apotti-system. The document does not describe the improvements in technical matter, which makes the document understandable to not only technical experts. The improvement document includes four parts that require improvement, these are: (a) Report, (b) Maximum payment limit certification, (c) Adding non-Apotti welfare areas invoices to the system for reporting, (d) Workqueue. The improvements *in the report* will make the health- and social care data visible in the same report. There is also a *calculator* that follows the accumulation of maximum payment charges; the purpose is to detect easily when the limit is reached. The maximum payment limit *certifications* will be used more widely in the Apotti system. This means



that the end users can print different documents in the area of maximum payment. Also, possible future regulations require the welfare areas to be responsible to follow the accumulation for the residents. Therefore, it is useful to add *non-Apotti using welfare areas invoices*, so they become visible in the report.

In the future, the possibility to import data from the report to the workqueue will be investigated, configured and implemented. This would make the patients that have reached the limit appear automatically in the workqueue, without anyone manually running the report.

The proposal was validated and approved by the product manager of hospital billing. The improves described in the document makes the end user organizations work more efficient and reliable. After the implementation the end users will have more time to focus on other matters.

## 7.2 Thesis Evaluation

The objective of this study was to propose a plan on how to proceed with the necessary build in 2023 and 2024 to improve the workflow. The outcome of this thesis is a development plan. The data of this study was collected from several different sources; from end-user organization representatives, documents, and the employees of Apotti Oy. The data was informative and with the collected data it was possible to create a solution to the problems found in the CSA. The study provides to the Apotti Oy a plan on how to improve the necessary parts of the Apotti-system to create value to the end users.

## 7.3 Closing Words

The last section is about my own reflection on the process of writing this thesis. Information systems are used in various areas of the world and making them more efficient is important. Healthcare IT systems require continuous improvement so that the end users can concentrate on the actual work and not to survive with ineffective processes. Using different methods from existing knowledge to improve processes and IT systems helps organizations to deliver value to the customers.

Personally, this study was interesting and informative to conduct. The maximum payment limit is a topic that has required improvement. This study helps the end users drastically, by making their work more efficient, by giving them time to focus on what truly matters and by ensuring the quality of their work with reliable processes.

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**Appendix A. Questionnaire**

	Questionnaire
1	Has the maxpayment limit workflow become more quicker after Apotti system?
2	How many softwares are you currently using on the whole process?
3	How many maxpayment limit certificates do you grant yearly?
4	When patient informs the customer fee unit that the maxpayment limit has been reached, how long does it take from the notice to the certificate? Before Apotti and after Apotti?
5	What part of the process takes the most time currently?
6	Which part of the workflow is currently the most problematic
7	Which parts of these tools needs most development? Maxpayment report, Maxpayment workqueue, The maxpayment limit certificate?

## Appendix B. Interview field notes 29.3

### Maxpayment limit workflow

Interviewees	Pekka Paukkonen
Interviewee	Tomi Lindstedt
Date and Place	29.3.2023 / Teams video conference
Time	13.25-14.05
<b>1. What is Your current position in the organization?</b>	Product Manager, in financial management services
<b>2. Have you received any feedback or complaints from customers regarding the maxpayment limit process</b>	<p>Yes, it is awaited and important enhancement int our system.</p> <p>Customers have informed that there is potentially coming new laws according to the responsibility of who follows the maxpayment limit accumulation for residents.</p>
<b>3. How has the workflow improved in the last year?</b>	<p>There have been improvements in the reporting tool in customer userface.</p> <p>Workqueue has been improved and the possibility of printing the maxpayment limit certificate with customers information is added.</p>
<b>4. How do you see that the workflow should be improved?</b>	The workflow should be improved according to the demands of the customer. The system should follow the accumulation and the possibility to add invoice data from other welfare areas that are not using Apotti system.
<b>5. What parts of the workflow should be automated?</b>	The system should recognize patients that have already went past the maxpayment limit.
<b>6. What kind of timeline do you see suitable for the new development</b>	Target deadline for new development should be the spring 2024.

## Appendix C. Workshop field notes, 31.3.2023

### Maxpayment limit workflow

Interviewees	Pekka Paukkonen
Interviewee	Application Coordinator A, Application Coordinator B
Date and Place	31.3.2023 / Teams video conference
Time	14.00-15.45
<b>1. How many tools do we currently use in the maxpayment limit workflow in the Apotti-system?</b>	<ol style="list-style-type: none"> <li>1. Workqueues</li> <li>2. Report</li> <li>3. Maxpayment limit certificate</li> </ol>
<b>2. What is the process currently in the Apotti-system</b>	<ul style="list-style-type: none"> <li>• Either the patient has reported that resident has reached the maxpayment limit, or the patient is in a workqueue</li> <li>• From the report <ul style="list-style-type: none"> <li>○ Add the patient id to the report</li> <li>○ Run the report</li> <li>○ Verify that the patient has reached the maxpayment limit</li> <li>○ Print the maxpayment limit certificate through the report</li> <li>○ Add the maxpayment limit coverage to the patient, so that the upcoming charges are automatically with the correct prices.</li> <li>○ Credit incorrect invoices</li> <li>○ Fix the prices for the maxpayment limit charges</li> </ul> </li> </ul>

	if necessary and create the debit invoice.
<b>3. How long does it take to run a report for a patient from a whole year?</b>	It depends on how many invoices the patient has had or at what time of the year the report is runned, but approximately 5 minutes.
<b>4. If the user knows already that which invoices needs to be corrected and where the maxpayment limit coverage needs to be attached, how long does this take in the system?</b>	Done by application coordinator:  Test case went through in 10 minutes.
<b>5. How many different screens does the end user sees when doing this workflow</b>	Ten different screens if all steps need to be done when fixing (adding coverage, fixing incorrect invoices, crediting, and debiting).  When doing the calculations inside Apotti. Three (Running the report and going through the tabs)  When printing the certificate seven.



## Appendix D. Workshop field notes, 17.05.2023

## Maxpayment limit workflow

Attendees	Pekka Paukkonen
	Application Coordinator A, Application Coordinator B
Date and Place	17.5.2023 / Teams video conference
Time	12.00-16.00
<b>1. Which tools should we improve</b>	<ol style="list-style-type: none"> <li>1. Report</li> <li>2. Maxpayment limit certificate</li> <li>3. Workqueue</li> <li>4. Charge Batch Entry</li> </ol>
<b>2. How the report should be improved</b>	<p><b>Important focus areas:</b> Health and social care in same report Cumulative follow daily</p> <p><b>Parameters</b></p> <ol style="list-style-type: none"> <li>1. Year</li> <li>2. Patient (or multiple chosen patients)/ All</li> <li>3. Maxpayment limit has went over: (Yes or NO)</li> <li>4. Maxpayment added already: <b>yes</b> vai <b>no</b></li> <li>5. Service area: All or Specific</li> </ol> <p><b>When runned with a specific patient:</b></p> <ul style="list-style-type: none"> <li>• Health- and social care charges in the same report on service date order. Including price, has they went to SAP, etc</li> <li>• Cumulative follow, that adds the charges euro amounts. This allows the end users to follow the maxpayment limit with daily accurate.</li> </ul> <p><b>When its runned with all:</b></p> <ul style="list-style-type: none"> <li>• Summary with name (hetu) euro amount.</li> </ul> <p style="text-align: center;">○</p>
<b>3. How should the maxpayment limit certificate be improved.</b>	<p>Involve all the necessary data</p> <p>Involve different languages for certificates.</p> <p>Involve different certificates</p>

<b>4. Workqueue</b>	Currently workqueue is not serving completely. The information from the report should be imported straight to the system.
<b>5. Charge batch entry</b>	Charge batch entry tool will be used to serve the possible legislation change, so that the invoices made in other non-apotti using welfare areas invoices can be documented in Apotti.

## Appendix E. Workshop field notes, 30.05.2023

### Maxpayment limit demo + workshop

Attendees: 10 end-users, 4 Application coordinators
<p>Demo from the system about how the maxpayment report is runned currently and how the maxpayment limit document can be printed from the system.</p> <ul style="list-style-type: none"> <li>• Maxpayment certificate birth date can be deleted</li> <li>• The hetu should be added after name</li> </ul>
<p>Maxpayment limit certificate should include language versions of Swedish and English, also document "Maxpayment limit not reached" should be able to be printed from the System</p>
<p>Presenting the current possibility of the new report, discussion and thoughts were exchanged.</p> <p><b>Important focus areas:</b>  Health and social care in same report  Cumulative follow daily</p> <p><b>Parameters</b></p> <ol style="list-style-type: none"> <li>1. Year</li> <li>2. Patient (or multiple chosen patients)/ All</li> <li>3. Maxpayment limit has went over: (Yes or NO) = Here we thought that could be so that they can just add euro amount. (Because it changes every other year) <ol style="list-style-type: none"> <li>1. So over euro: 692, (or some other amount)</li> </ol> </li> <li>4. Maxpayment added already: <b>yes</b> vai <b>no</b></li> <li>5. Service area: All or Specific</li> </ol> <p><b>When runned with a specific patient:</b></p> <ul style="list-style-type: none"> <li>• Health- and social care charges in the same report on service date order. Including price, has they went to SAP, etc</li> <li>• Cumulative follow, that adds the charges euro amounts. This allows the end users to follow the maxpayment limit with daily accurate.</li> </ul> <p><b>When its runned with all:</b></p> <ul style="list-style-type: none"> <li>• Summary with name (hetu) euro amount.</li> </ul> <p>Report can be exported to excel.</p> <p>End users did not add any more specifications for the report. After implementation and usage they are able to give better view.</p> <p>Comment from end user: The planned changes are looking promising</p>

## Appendix F. Workshop field notes, 12.06.2023

## Maxpayment limit workflow

Interviewer	Pekka Paukkonen
Interviewee	Product Manager
Date and Place	12.6.2023 / Teams video conference
Time	12.00-13.00
1. Is the maxpayment limit workflow improvement document understandable?	"Yes, the document is understandable and comprehensive"
2. Based on the demand from customer, does this plan answer to the needs? Does it answer to the other requirements we have gathered?	"Yes, the improvement document does answer. It also includes future enhancements, topping the original requests"
3. Does the schedule make sense?	"Schedule is realistic and acceptable"
4. Do you have any suggestions for the document?	"The improved parts could be described maybe more in detail"
5. Do you approve the document?	"Yes, the document is approved"

## Appendix G. Plan

### MAXPAYMENT LIMIT WORKFLOW IMPROVEMENT DOCUMENT

#### **Maximum Payment Limit Workflow Improvement Document**

##### **Introduction**

This improvement document is based on the research done by Pekka Paukkonen, in the Metropolia University of Applied Sciences Master's Thesis "*Maxpayment Limit Workflow Improvement*"

This document is made to address the outcome of the research, it lists the improved areas and the improvements planned to be made in the years 2023-2024.

This document does not include the technical specifications, they are addressed with the case company's own tools.

##### **Improvements**

The maxpayment limit workflow will have improvements in the following areas:

##### **2023:**

- Report
- Maxpayment limit certification
- Adding non-Apotti welfare areas invoices to the system for reporting purposes

##### **2024:**

- Workqueue update

#### **1. Report:**

The report will include both health- and social care data from the system, they will be listed by the service date. Accumulation calculator will follow the charge. With this report the user is able to see the exact date when the maxpayment limit is reached.

##### **Parameters**

1. Year
2. Patient (or multiple chosen patients)/ All
3. Maxpayment limit has went over: (Yes or No)
4. Maxpayment added already: yes vai no
5. Service area: All or Specific

##### **When runned with a specific patient:**

- Health- and social care charges in the same report on service date order. Including price, has they went to billing system, etc

## MAXPAYMENT LIMIT WORKFLOW IMPROVEMENT DOCUMENT

- Cumulative follow, that adds the charges euro amounts. This allows the end users to follow the maxpayment limit with daily accuracy.
- The report can be exported to excel for further calculations.

### When the report is runned with all patients:

- Summary with name (hetu) and euro amount.

## 2. Maxpayment limit certification

Other documents from the area of maxpayment limit will be added to the workflow. These are sent to Apotti from the end-user.

These include documents with different languages and to address a situation where the maxpayment limit is not reached.

These documents need to be gathered from all the Apotti-using welfare areas. Header and footer information differs.

## 3. Adding non-Apotti welfare areas invoices

A charge batch entry tool will be used when non-Apotti using welfare area invoices are added to Apotti. This workflow will use a dummy charge for reporting purposes since these charges are not going to be billed from Apotti system.

The reason is only to make them visible in the maxpayment limit report to meet the possible legislation changes in the accumulation following responsibility.

## 4. Workqueue (2024)

The possibility for importing data from the report will be investigated, configured and implemented latest next year.

Patients who have reach the maxpayment limit will be automatically detected with the data from the report and the information is imported to the system to mark them to swim to the workqueue.

### Implementation plan

The implementation for the Aug-March for the 2023 improvements and the 2024 improvements will be implemented in the spring 2024.

MAXIMUM PAYMENT LIMIT WORKFLOW IMPROVEMENT DOCUMENT

Maximum payment limit report	
<b>How it was</b>	<b>How it will be</b>
Health- and social care in different reports	Health and social care in the same report
Year and patient as only parameters	Possibility to see the exact date when the maxpayment limit is reached
List of maximum payment limit charges for the sepdific patient	Option to choose multiple patients
Ordered by the invoicing date	Option to choose if the report will show patients that have or have not reached the limit
	Is the maximum payment limit already added to the patient
	Which service area to choose
	Summary levels with name, social security number and the accumulated euro amount
Maximum payment limit certification	
<b>How it was</b>	<b>How it will be</b>
Limited possibility to print the certification	Possibility to print the maximum payment limit certification
	All the maximum payment limit documents from the Apotti using welfare areas
	Different language versions
	Patient information populated automatically
Adding non-Apotti welfare areas invoices	
<b>How it was</b>	<b>How it will be</b>
No possibility to add other welfare area invoices	Possibility to add other welfare area invoices by using a tool called charge batch entry
	Dummy charge for every welfare area
	Charges are not possible to invoice from Apotti
	Only to be visible in reporting
Workqueue	
<b>How it was</b>	<b>How it will be</b>
Organization A	Automatically add patients which have reached the accumulation from the maximum payment limit eligible charges
Only patients that were inpatient and had continuous 17 day stay	
Organization B	
Patients that has charges with more amount than +600eur	

Action Plan			
Apotti tool	Responsible Team	Start	End
Maximum Payment Limit Report (Usability / TIME)	Reporting team, Hospital Billing Team,	8 / 23	30 / 11
Maximum Payment Limit Certification (Usability)	Hospital Billing Team, Communications	8 / 23	30 / 11
Adding non-Apotti welfare areas invoices (Charge Batch Entry) (Usability)	Hospital Billing Team	8 / 23	30 / 11
Workqueue (TIME)	Hospital Billing team	8 / 23	30 / 11