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CroKuS: Improving work processes and perceived customer satisfaction with the help of mobile technology

Bachelor of Science Thesis in Software Engineering and Management

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Abstract
Today, many organizations are lacking an understanding of how mobile technology could benefit both the organization and its customers. Could mobile technology not only help organizations increase efficiency but also the perceived customer satisfaction? The thesis develop a prototype in the form of a smartphone application which explores the value of mobile technology. The result shows how the perceived customer satisfaction is mirrored in the improvement of an organization's efficiency.

1 Introduction

Mobile devices are nowadays very common in most peoples' personal lives. Also, many organizations are starting to, or have already started to, incorporate these devices into their daily operations (Viehland and Yang, 2007; Coursaris et al, 2006; Sheng et al, 2005; Liu, 2010). Studies have shown that mobile technology can help organization increase productivity and/or effectiveness (Viehland and Yang, 2007; Coursaris et al, 2006). Furthermore, Viehland and Yang (2007) show that mobile technology can help organizations improve customer relations. Despite this, Nah et al (2005) argue that organizations and their customers lack an understanding of the value that mobile applications provide. Hence, the aim of this study is to explore whether mobile technology not only can help organizations increase efficiency but also the perceived customer satisfaction. We argue that the perceived customer satisfaction is affected by the organizations work processes. An organization's work processes refers to the different day-to-day operations that needs to be performed in order to achieve goals. The purpose of this study is to develop a prototype in the form of a smartphone application. We named the prototype CroKuS. CroKuS is implemented at a repair shop within the vehicle industry. In order to develop CroKuS we have explored *how an organization, through mobile technology, can increase the efficiency of its work processes and thus improve the perceived customer satisfaction.* In this study, *efficiency* refers to the shortened lead time in the organization when handling customer support cases or similar situations depending on the type of business the organization is involved in. On the other hand, *perceived customer satisfaction* refers to the customers experience when interacting with the organization. The perceived satisfaction is difficult to measure, but it is still important and constitutes rather a phenomenon that only becomes visible ones the surrounding variables have been corrected, which in this case is the efficiency of the work process.

The research within mobile technology has focused mostly on the cost reduction and the increased efficiency aspects of the work processes (Viehland and Yang, 2007). This study takes a different approach since, aside from the increased efficiency, it also explores the organization's customers' perceived satisfaction when they are dealing with the organization. Thus, the increased customer satisfaction is an important part of our research and an interesting topic as it has not been focused upon in previous research.

To explore this question we use Volvo Penta as an empirical partner. The method that we have selected for this research is a design research approach (Vaishnavi and Kuechler, 2004/5, Hevner et al, 2004) (See section 3). The first part of this approach is to perform an observation and an interview, aiming at collecting necessary data with the purpose to understand the current work process. The second part is to develop a prototype (CroKuS) in order to explore our belief that mobile technology can increase the efficiency of an organization's work process and thus, improve the perceived customer satisfaction.

Our contribution to practice is a prototype that creates a more efficient work process by supporting better communication and information sharing among the staff, which could lead to an increased customer satisfaction. Our theoretical contribution is an increased understanding for how mobile technology can be used to enhance the efficiency of a work process and with that improve the perceived customer satisfaction.

This paper continues with describing pertinent literature within the field of mobile technology (section 2). Section 3 describes the method used to collect and analyze the data as well as the research process and the research settings. We present the findings of the study in section 4 and discuss our findings in section 5.

Finally, we present the conclusion of our study in section 6.

2 Related research

2.1 Mobile technology

The concept of mobile technology consists of two different aspects, on one side there is the hardware and on the other side there is the software. With today's smartphones, it is in most cases the software that is the limitation to what the user can get out of the device. The hardware in smartphones does not differ all that much between manufactures and models. Most of the smartphones have access to; high speed Internet connection, GPS, built in camera, bluetooth and touchscreen. It is through the software on the smartphones that the users can take full advantage of the phones capabilities. Software on smartphones comes in many different shapes. There are the general purpose applications such as weather services, tv-guides and so on. Then, there are applications that are designed exclusively for organizations in order to help them in their daily operations. Examples of such applications are organizations that offer wireless solution to its customers for tracking packages and verifying delivery, or organizations that provide customer banking services and employee access to corporate applications, or applications that allow nurses and physicians to access secure clinical information at the point of care. These applications are generally not available for public use, but it is clear that they help companies both within and across organizational boundaries since they support computing on the move using portable devices (such as smartphones) through wireless networks (Nah et al, 2005).

Related research within the field of mobile technology show that organizations can improve existing work processes by utilizing the benefits of mobile devices (Viehland and Yang, 2007). For example, Viehland and Yang (2007) states that, by using mobile technology, the service workers can begin their day without the need of visiting the office since they can access their job queue and go directly to a service call. Also, the service workers can access supplier records and order parts without going through the office.

Furthermore, research has also shown that customer relations can benefit from mobile application and technology (Coursaris et al, 2006). Liu (2010) argue that it is very important to understand how mobile service companies should interact with their customers and deliver services in electronic environments. One of the suggestions from Liu (2010) is to provide mobile phone users with real time information. Another suggestion is that the company can develop customized mobile services for different users' needs.

Furthermore, Nah et al (2005) claims that the advantages of mobile applications include mobility (do business anytime and everywhere), flexibility (data can be captured at the source and users can engage in other activities) and dissemination (disseminating real-time information to a large user population).

2.2 Mobile technology and value creation

2.2.1 Value creation of work processes

Nah et al (2005) argue that organizations and their customers lack an understanding of the value of mobile applications. Keeney (1992), in Nah et al, defines value as the principles for evaluating the consequences of action, inaction or decision. Furthermore, Coursaris et al (2006) claims that value creation can occur by supporting either mobile users (e.g. employees or customers) or mobile activities (e.g. tracking raw materials and supplies), and that it is based on three fundamental attributes of mobile technology. Those three are connectivity (24/7 connectivity supporting anytime and anywhere communication and information exchange), personalization (personalize the interface and application settings may not only increase their satisfaction with using the device but may also improve the efficiency and effectiveness of using the system) and localization (adds a new dimension to reachability extending from the Internet's ability to reach a location).

Sheng et al (2005) states that IT is a critical resource for creating organizational value and by extending computing and the Internet into wireless medium, mobile technology provides greater flexibility in communication, collaboration and information sharing. The study of Sheng et al (2005) identified by the implementation of

Tablet PC's into an organization, that the organization could increase the efficiency since the workers can acquire more work orders per day. Another outcome of their study, related to the value creation of work processes, is the cost reduction since they identified evidence that the company could save some money by their digitalized solution.

2.2.2 Value creation of customer satisfaction

Customer satisfaction is important to an organization since the organization has to fulfill the customer's needs to secure competitive advantage (Fagrell, 2000). In this study, value creation of customer satisfaction refers to how an organization could give the customers a better experience when dealing with the organization.

Kuschel and Ljungberg (2004), discovered the importance of customer involvement when diagnosing a vehicle and we believe this involvement will satisfy the customer and thus increase the value creation. The reason is that the customer “share their experiences of the boat, to discuss the conditions under which the problem occur, or even try out the boat again and report back”. Kuschel and Ljungberg (2004) notice this as the *importance of collaboration* but that it should be noted that the technician would always tell the customer about technical problems that could cause damage. That is, diagnose the problems experienced by the customer is equal important as to diagnose the technical problems of the vehicle. Thus, we have a difference between a perceived problem and a technical problem. Additionally, Kuschel and Ljungberg (2004), claims that the perceived problems and the technical problems would probably overlap in many cases, but to assume that they would overlap in all cases would be wrong.

3 Research design

3.1 Research setting

To perform this research we have approached Volvo Penta as an empirical partner. Volvo Penta is one of the market leaders in the boat manufacturing industry. They also provide service and repair for Volvo Penta boats. We have conducted our study at one of their service and repair shops.

They are about 15 people working at the selected repair shop, which is from our understanding a fairly common size for a Volvo Penta repair shop. These 15 are both technicians and receptionists, who communicate with each other. They receive about 10-15 new boats every day that needs to be fixed in some way. The environment at the repair shop is stressful which could lead to missed deadlines and service delays for the customers. There is no current computerized system that helps the staff to plan and keep track of the work. The only computerized system is a device that helps them diagnose the boat. This is a hand held device called Voodia. Instead they are working with pen and paper and they have meetings twice a day where the work tasks are assigned to each and every technician. The technicians have a certain competence (such as electrician or mechanic) and are assigned to a case depending on this competence and the specific fault of the boat. During the meetings, the work process of each case is set. It is important to plan and prioritize the work flow of every work order since errors often are related to each other and since the technicians have different areas of expertise that needs to be used effectively to ensure that deadlines are kept. Communication has to be done between the different areas of expertise to share and update information of the work process. During these meetings, there are no additional interactions with the customer.

Furthermore, the customers could either call on before hand to book an appointment or rather just show up when an error occur. When the customers hand in their boat for a service or repair, they interact with the receptionist and not directly with a technician. The receptionist creates a work order which is later handled on one of the meetings among the technicians.

3.2 Research approach

Since this is a problem-solving study, the method selected for this study is design research approach (Vaishnavi and Kuechler, 2004/5, Hevner et al, 2004). Design research consist of one behavioral-science part and one design-science part. To reach the desired efficiency in the organization and increase the perceived

customer satisfaction, we believe that these two distinct but complementary parts help us to explore our research question. For the behavioral-science part we use a qualitative approach when observing the current work process of a repair shop. In the design-science part we develop CroKuS which explores the possibility to improve efficiency and perceived customer satisfaction within the organization.

This study is divided into five different phases (see figure 1). These are *observation*, *interview*, *analysis*, *prototype development* and *evaluation.* The first phase is when we observe the current work process at the repair shop. The purpose is to get an understanding of how the repair shop's work processes operate today. The second phase is an interview with the foreman at the repair shop where our aim is to understand what he considers to be problematic in the current work process as well as what he suggest as a more ideal work process. Phase three is where we analyze the notes that we took during the interview and observation. With the analysis, the aim is to find the requirement specification for CroKuS. Phase four is where we develop CroKuS. Phase five is an evaluation where we demonstrate CroKuS for the foreman at the service and repair shop with the purpose to see if mobile technology can improve the work process.

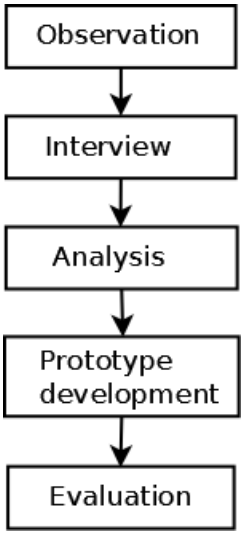

Figure 1: Research process

3.2.1 Phase 1 - observation

The goal of the observation is to get an understanding of how the repair shop's work processes operate today. This understanding of the work process is performed so that we, without the influence from the staff at the repair shop, could try to get an idea of where and how mobile technology would be used to improve the work process. The work process is observed from a distance rather than getting involved in the process itself. That is, we do not intervene in the process to ask questions when there is something that is unclear to us. The outcome of the observation is written notes that the two researchers will take while observing the work process. The knowledge from this phase is then used as an input to the qualitative interview in phase two.

3.2.2 Phase 2 - interview

We selected the foreman for the interview since he has a central role at the repair shop as the owner, but also as a technician. He oversees and schedules much of the work at the repair shop. The foreman is selected for an interview due to his expert knowledge within the field. He is recommended to us by two experts from Volvo Penta's aftermarket segment. These two experts guarantee that he will present a representative overview of how Volvo Penta's repair shops are operated and that he will be able to answer our questions. The interview is in a semi-structured nature (Creswell, 2002) where we aim to understand what the foreman considers to be a more ideal work process for the staff at the repair shop. Again, written notes are taken by both of us during the interview. The goal is to complement the understanding we got from our observation with in-depth expertise expressed by the foreman. The aim is to gather the foreman's own experiences, reflections, local knowledge and general understanding of the work process and thus be able to understand the ideal work process. Our interview notes are later used as a means to extract requirements for CroKuS. With CroKuS, we want to reduce the problems that employees experience and further build on the strengths of the current work process.

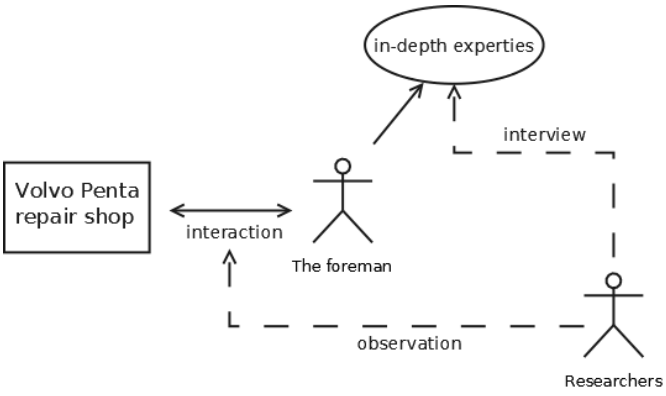

Figure 2: Data collection from observation and interview

3.2.3 Phase 3 – analysis

With the analysis, the aim is to find the requirement specification for CroKuS. We will not only use the points brought up by the foreman during the interview as a requirement specification. Instead, we analyze the data from both the observation and the interview to get our own knowledge of how to improve the work process by understanding where and how mobile technology could be implemented and to have sufficient data to explore our research question. To be able to find the requirement specification for CroKuS, we are inspired by grounded theory (Glaser and Strauss, 1967) as a data analysis method when analyzing our observation (phase 1) and interview (phase 2) notes. The purpose of using Grounded Theory is to categorize and relate identified problems and strengths. The input for this phase is the data collected from phase 1 and 2. The first step is in Grounded Theory called open coding. Here we group the identified problems to a category. This step is a process where we will break down, analyze and compare the problems and strengths to find different categories. An example of two problems is *Technical problems and perceived problems are not attached to the same work order* and *customer interaction is only done during the interaction of the work order.* These two are for example grouped to a category called *Efficient record keeping of work orders.* This is done to make the problems more workable and we will consider questions such as *What does this stand for?* and *What does this mean?* The result is an initial conceptualization of the categories. The second step is called axial coding, and we relate the different categories to each other based on the similarity of the identified categories, and elaborate around these. The outcome of this phase is different categories that serve as requirements for CroKuS.

Phase 4 - development

This development is supported by the design-science approach. Here, we develop CroKuS based on the outcome of the previous phase. CroKuS was developed on the android platform (see section 4.4.4 for a system description).

3.2.5 Phase 5 – evaluation

The purpose of the evaluation is to validate

Phase	Purpose	Outcome
Observation	Understand the current work process	Base for the interview
Interview	Understand the ideal work process	Problem identification
Analysis	Understand how problems and strengths in current work process could be improved with mobile technology	Requirements for the prototype
Development	Develop a prototype	A prototype that prove our theory
Evaluation	Validating the prototype	Validation

Table 1: A summary of the research process, i.e. the phases, purpose and outcome

CroKuS in order to prove if the implementation of mobile technology would help the repair shop improve its efficiency, and thus the perceived customer satisfaction. The evaluation is in the form of a workshop together with the foreman where we demonstrate the functionality of CroKuS, such as better communication and information sharing. During the demonstration we show how CroKuS can be integrated into the repair shop's work process in order to improve the overall work flow of the daily work.

3.3 Limitations

To limit the scope of the study, data is only collected from one person. However this person came recommended to us by two after market specialists at Volvo Penta and they claim that he would be able to provide us with the information that we required and that his answers would reflect Volvo Penta as an organization. We assume that their is a standard work procedure followed by every service technician. This study has only been performed on one organization, but still the results would be of interest for other organizations with similar conditions.

4 Result

4.1 Volvo Penta's work process

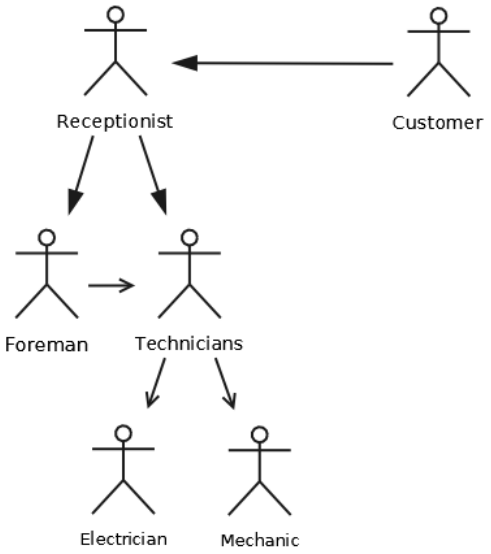

Figure 3: Stakeholder analysis

During the observation phase we acquired an understanding of how the repair shop's day-to-day operations are handled. What we could see was that new boats mostly arrive unannounced to the service dock. It is also worth mentioning that some customers show up during nighttime. When the workday begins, the receptionist registers all the new customers and creates a work order along with an estimate of the cost and time of the repair. This creation of a work order is done as soon as a new boat arrives. When the work order is created, the receptionist asks the customer what he believes is wrong with the boat. This information, along with the information the service technician gets when he runs a full diagnostic test on the boat, is used as a base for what needs to be done to the boat. This is the only customer interaction in the current work process. The diagnostic test is done with a device that interacts with the boat. The purpose of the diagnostic test is to find technical problems. The device shows the error codes in a format like PID 102, which in this case means problems with the boost pressure. The technician is supposed to interpret all error codes that the he gets from the diagnostic test. To his help, he has a manual with all error codes. It is worth to point out that depending on the customer's problem, a diagnostic test of the boat might not be necessary. Also, the information from the customer is not attached to the same work order as the result from the diagnostic test. Furthermore, the work tasks of the day are decided at a breakfast meeting where everyone gets his task(s) assigned. The next meeting is at lunch. This is more of a status meeting where the technicians get a chance to talk and update each other of the work that has been done, but also decide about problems that might have arisen after the breakfast meeting. The rest of the day is spent repairing boats. When the technicians complete a task they move on to the next one as planned during the meeting. When they use a repair part, they have to write it down on the work order in the reception. The total time spent on each work order is also written down on the work order. Once the repair is done, the customer is informed that the boat is ready for pick up. Finally, it is not unusual that the staff have to work overtime in order to meet deadlines. The above described work flow is illustrated in figure 3 and figure 4.

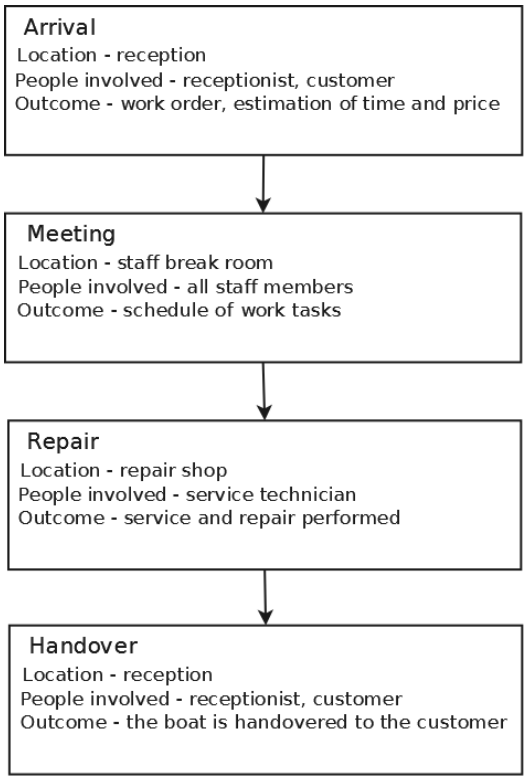

Figure 4: Illustration of the work process

4.2 Strengths and problems in the work process

From the interview, we got an understanding that a digitalized work order in the form of a mobile application would have the potential to help the repair shop increase its efficiency. A desire was notified during the interview as "*always having an up to date work order where you can see who is working on what*". The work orders are today created on a computer and then printed and updated manually leaving much room for the occurrence of human errors (i.e, a technician misses to add a used repair part or the time spent on the case is wrong). To help us design the digital work order, the repair shop provided us with an actual copy of a work order that they use today. Furthermore, from the fact that they only have two meetings, we have identified a potential gap where the staff does not know if there are any work orders that they can start working on. Also, a large portion of customers show up unannounced at the repair shop. The repair shop offers a "drop-in-service" in parallel with the pre-booked service. Unannounced customer visits means that planning the daily work is not an easy task.

Strengths
The receptionist creates the work orders since she has access to the database
The receptionist prepares the case/work order by collecting data about the perceived problem

Table 2: Identified strengths in the current work process

Id	**Problems**
1	A diagnostic test does only take place if necessary and not regular
2	Technical problems and perceived problems are not attached to the same work order
3	Customer interaction only during the creation of a work order
4	Information is only shared among the technicians twice a day
5	There is not a good solution for tracking the progress of the repair
6	The staff is forced to work overtime in order to meet deadlines
7	Used repair parts and total time spent on a repair are attached to the work order manually

Table 3: Identified problems in the current work process

During the interview with the foreman there was a desire that, as he explained, "*it would be great if the customer could supply us with the error codes on beforehand*". Another comment from the foreman was that "*it would be better if it was easier to re-plan and reallocate tasks and technicians gradually*". Additionally, during the interview, we understood that it is important for the customer to get a clear and simple answer on when the boat is done.

Furthermore, we also got an understanding that hidden errors (i.e. errors that are found only when the diagnostics are run but are otherwise unknown to the customer) can be found and that what the customer describes as a problem might not actually be the real problem. For example, a customer can arrive to the repair shop and describe what he perceives as a problem. The technician might recognize the problem and by experience repairs what the customer described. Later, the boat breaks down due to a hidden error which would have been detected by a diagnostic test.

From the observation and interview, we learned that there are the following strengths (table 2) and problems (table 3).

4.3 Problem categorization

We have categorized the seven problems into three problem categories (see table 4). We relate problem 4 and 6 to each other since these two would refer to collaboration and information sharing among the staff. We call this category *Efficient resource allocation* and the problems are related to a better planning of the work process. Problem 1, 2, 3 and 7 relate to each other since they all refers to the work order and how to communicate the different problems of the work order. We call this category *Efficient record keeping of work orders.* Problem 5 is about the status of the repair. We call this category *Efficient work order status awareness.* This category aims at helping the organization reduce the look-up time for investigating the progress of a work order.

The three categories represent requirements for the prototype. All the requirements are, of course, about making the work process more efficient. We have only identified two strengths. That is, there has been no reason for categorizing the strengths.

4.4 Prototype development

The three identified problems categories represent a requirement specification for suggesting a solution. Thus, they should be seen as requirements for CroKuS. This section elaborates around the requirements to prove how and why mobile technology solves the problems as well as how we believe these solutions impact the perceived customer satisfaction.

4.4.1 Efficient resource allocation

The overall idea with this requirement is to eliminate the need for daily meetings. We saw that the two meetings that are held each day are ineffective since, first of all, they share information only twice a day and, secondly, they have to collect every technician and thus interrupt the work process. We saw a need for collaboration and information sharing among both the technicians and the receptionist anytime and anywhere. The introduction of a digitalized work order in a mobile application gives the opportunity for each technician to have an up-to-date list of cases that needs his attention, rather than waiting for scheduled meetings. Our proposed solution is that a technician with the appropriate competence is assigned to it when the work order is created. There is also an opportunity to prioritize the work orders, which further reduce the needs for

Problem	Category
4, 6	Efficient resource allocation
1, 2, 3, 7	Efficient record keeping of work orders
5	Efficient work order status awareness

Table 4: Problems related to a category

scheduled meetings and lets the technician choose the work order with the highest priority. From the technician's perspective, whenever he uses CroKuS he can see which work orders that are assigned to him at anytime and from anywhere. When the technician is done with his task(s) on a work order, it gets automatically reassigned to the next technician who can perform other repairs that are within his competence area. Today, work orders are only printed and kept in a paper format. By using CroKuS, the technicians can access the work orders through the mobile application anytime and anywhere since they are now digitalized.

4.4.2 Efficient record keeping of work orders

This requirement aims to benefit both the technicians and the customer. Today, the work orders are based on what the customer perceives as a problem. Once a technician starts working on a boat and if they see the need for it, a diagnostic test is performed. The problem is that the results from the diagnostic test are not stored together with the work order. This can lead to that multiple diagnostic tests are performed on the same boat. This is a rather time consuming activity and it increases the repair time for the boat. Thus, we saw an opportunity to improve the work process by combining the information provided by the customer together with the results from the diagnostic. The proposal is that CroKuS has all the collected data (technical problems and perceived problems) about the boat in one place. From the customer's perspective, this means more accurate information on what has been done on the boat. Another major improvement from the customer's perspective is that by having a more efficient work order, the repair of the boat has a shorter life cycle. Indirectly, that means lower repair costs.

Additionally, to make the work order more efficient for the organization, CroKuS has a functionality that supports reporting of the time spent by each technician on the work order. Also, the technician can easily add used spare parts on the work order by scanning the bar code of the used parts. This is done by using the camera on the smartphone. The used parts are then automatically added to the customers bill. Today, this is done manually, which according to the foreman, is time consuming.

4.4.3 Efficient work order status awareness

CroKuS builds on the idea of having a digitalized work order. The problem that is related to this requirement is that the managers of the service and repair shop could not track the progress of

Category	Suggested solutions
Efficient resource allocation	Every technician has a smartphone with a digitalized work order, up-to-date list of work orders, the receptionist assigns the technician from the central system, the technician re-assigns the next technician, opportunity to prioritize work orders
Efficient record keeping of work orders	Always perform a diagnostic test, results from diagnostic test is stored on the same work order as the perceived problem, used parts are attached to the work order automatically, time spent is reported from the prototype and stored in the work order
Efficient work order status awareness	The status of work order is automatically updated when progress is made by the technician

Table 5: Summary of solutions to the different categories

the different work orders in an efficient way. The solutions related to this requirement provides the managers at the repair shop with the ability to track the progress of work orders in real time as they get updated by the technicians. By using CroKuS, the status of the work progress could be of three different states. By updating the progress into different states, the managers could faster and more precisely answer and give feedback to the customer when the boat is repaired.

Table 5 aims to show the different solutions to each category. The solutions are all based on functions available with mobile technology.

4.4.4 System description - CroKuS

CroKuS has been developed on the android platform and tested on the HTC Wildfire handset. The programming language used is Java and we have developed on the IDE Eclipse with the Android plug-in. The underlying database is a SQLite database accessed from the smartphone, using socket communication. The Client-server model has been applied (see figure 5).

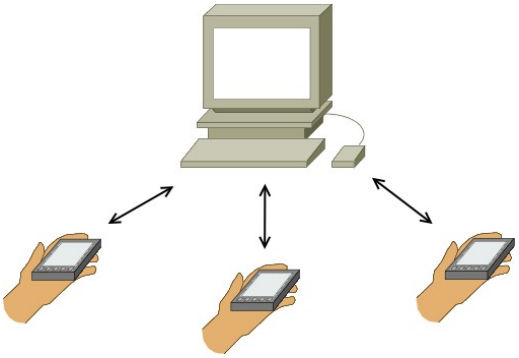

Figure 5: An overview of the suggested solution, i.e. each technician has a smartphone which is connected to the central system (client-server model)

4.5 Evaluation

To validate the requirements for CroKuS, we organized a workshop together with the repair shop's foreman. In the workshop we demonstrated our solutions. We demonstrated all solutions in an arrangement so that they reflected a work-day. That is, we started by showing the solution when the work orders are created from the central system and technicians are assigned based on his competence. Then, we showed all solutions in the smartphone, starting with the feature that allows a technician to sign in and see all his tasks. We continued the demonstration by showing the solution when a technician is done with his task(s) and handover the work order to the next assigned technician. Finally, we demonstrated how it is possible to look-up details regarding a specific work order from the central system.

The workshop aimed to investigate how CroKuS could help the repair shop improve its work process (see Table 6). As the requirements originate from the identified problems with the repair shops current work process, they are all familiar to the foreman. The workshop gave the opportunity for the foreman to see where and what problems CroKuS aims to solve, since the foreman greatly contributed to our understanding of the ideal work process. To be able to argue that mobile technology can improve an organization's work process, table 6 shows how much time (since efficiency refers to time in this study) the repair shop can save in the three different categories. The time is presented as minutes per work order. The column *Expected outcome* is the value we, on before hand, thought was possible to save. We chose seven minutes since we aimed to save a half-time post (the total time is 84 hours/month). The column *Expert's opinion* is what the foreman, with his expert knowledge, thought CroKuS would be able to achieve.

4.5.1 Efficient resource allocation

When we showed the solution for the foreman, we got very positive feedback on our way of interpreting what the foreman in the interview describe as their ideal work process. He directly saw the benefit that the solution could save approximately 15 minutes per work order because of the implementation of a central system that provides an overview of all work orders. This solution was described, by the foreman, as providing "great overview" and "easy to use and reallocate tasks" in comparison to what is used today. The foreman was

Category	Our estimation of saved time (min/work order)	Expert's estimation of saved time (min/work order)
Efficient resource allocation	7 minutes	15 minutes
Efficient record keeping of work orders	7 minutes	15 minutes
Efficient work order status awareness	7 minutes	15 minutes

Table 6: Results of the evaluation

especially pleased with the possibility to reallocate the manpower faster and on the spot. Another feedback was "an opportunity to prioritize the work orders and that the technician himself can assign the next technician will reduce the need for our meetings".

4.5.2 Efficient record keeping of work orders

Our idea of making the work orders more efficient in regards to the record keeping, we had estimated a gained time for seven minutes per work order. However, even in this solution, the foreman saw a potential saving of about 15 minutes per work order. According to the foreman, the reason for this is traced to the simple fact that the results of the diagnostic are stored with the work order, resulting in that the diagnostic will only have to be performed ones for each work order. Also, this reduces the need of manually reporting the used spare parts, which due to human errors can be forgotten when done manually and is time consuming.

4.5.3 Efficient work order status awareness

The foreman at the repair shop gave the feedback that this solution would be very useful since it collects all work orders in one digital place. If a customer calls the repair shop with questions regarding a work order, the lead time for investigating that work order could be reduced by up to 15 minutes. Since the digital work order always is up to date, the manager only has to press a button in the application to see the status of a work order. Comparing this to today's work process where the manager has to collect information from several technicians to be able to establish the status of a work order. During our interview with the foreman, we got to know that a fairly common scenario is that the customer after a completed repair wants to get in touch with the repair shop with inquiries about the final cost of the repair and what parts of the boat that has been affected by the repairs. As it is today, far from everything is documented in a way that it is easy for the staff at the repair shop to trace these kind of inquiries.

5 Discussion

The suggested solutions for each requirement have clearly explored one common goal, which is the time saved when implementing mobile technology since the three different requirements all serve, in one way or another, to make the organization more efficient.

The result of the three suggested solutions shortens the life-cycle of the repairs. Thus, one outcome is cost savings since the three solutions could together save up to 45 minutes per work order. This means that the organization could perform the same amount of work but with one less technician since 45 minutes per work order with ten work orders per day, is close to one full time post. From the organization's point of view this might be a desired outcome of a more efficient work process. But what does this savings mean to the customer? The various work orders are very different and do require different amount of time spent in order to repair the boat. The customer's bill is in the end often very expensive, and you could argue that 45 minutes of saved work time

is not that much. On the other hand, the high costs are often related to expensive repair parts. If the boat only has a minor repair (let's say an oil exchange) the time spent on the boat is maybe only up to three hours and then, 45 minutes of work time is a cost saving also for the customer. For the major repairs, which could take eight hours (or more), the benefit for the customer is that he gets his boat back faster from the repair. Furthermore, we would argue that another outcome that has more value for the customer is that the organization might instead use the saved time to ensure the quality of the repair, and thus increase the perceived customer satisfaction. Depending on the customer and the situation, the customers might have different views of what quality is. For some customers, quality could be that they get their boat back from the repair shop as soon as possible. For others it is the quality of the repair that defines their level of satisfaction. Since CroKuS shortens the life-cycle of the repairs, both aspects of how customers perceives quality are covered, thus it is up to the organization to make a stand on where and how they want their customers to perceive the quality of the work they perform. For example, a study in the German car industry have shown that the personal experience is of high concern when choosing a repair shop (McKinsey, 2010).

Furthermore, we argue that mobile technology also would increase the perceived customer satisfaction since the solutions to *efficient status awareness* contribute to that the customer could faster know the status of the boat's repair, which benefit both the customer and the technician. We believe that the customer feels more involved in the process if the feedback is fast and accurate. This is supported by Kuschel and Ljungberg (2004) who describes the importance of that the customer is involved when diagnosing the boat since diagnosing the problems experienced by the customer is equal important as to diagnose the technical problems.

Solutions to *Efficient record keeping of work orders* makes a more correct work order. For the customer, this means a more correct bill with accurate information about what has been done to the boat and used parts. Another problem that has not been discussed in the study is the occurrence of back orders. A back order is when a customer has to bring back the boat to the repair shop because the problems persists after the repair. Even if we do not have any empirical data regarding the occurrence of such situations, they surely have a negative effect on the perceived customers satisfaction. Although we can only speculate that this solution would reduce the number of back orders. The information in the work order is now collected in one location and thus increasing the probability of a correct repair the first time the customer brings his boat to the repair shop.

Since CroKuS only is a proof of concept, with a short development time, built to prove that mobile technology can help an organization improve its work processes, there is still much that have not been explored that further could increase the perceived customers satisfaction. An example of more a major improvement could be that also the customer has access to the prototype. Then, a further solution is that the customer, from CroKuS, could supply the repair shop with the error codes on before hand. That is, the customer has an own version of the application on his private smartphone where he can record sounds from the engine or take a photo of the dashboard (or wherever the problem is) and send to the repair shop before he arrives. This would shorten the repair time even more. Also, from CroKuS, the customer could be even more involved and the perceived customer satisfaction could increase.

Figure 6 below aims to show how our three suggested solutions, based on mobile technology, increases the efficiency of an organization's work process with the help of the customer's perceived problem and the technical problem. The figure describes all parts brought up in this research since it reflects how mobile technology, our requirements and the perceived problems belong and builds on each other to make a more efficient work process and thus improve the perceived customer satisfaction. The figure could be seen as the result of the knowledge and understanding we got during the research.

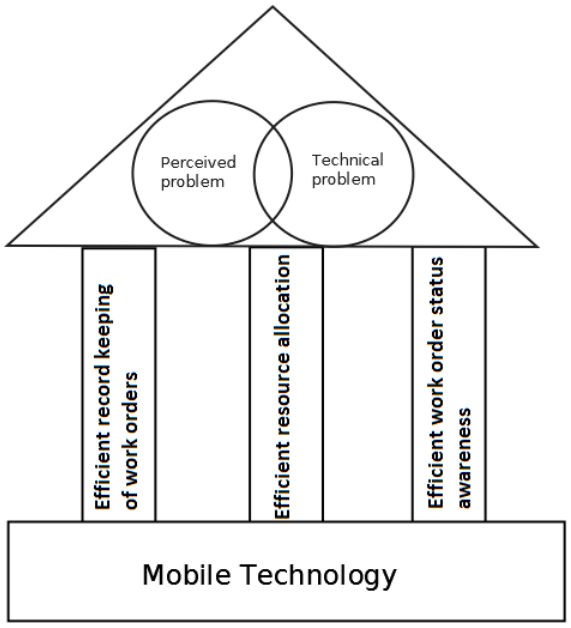

Figure 6: The conclusion of our theory, ie. how mobile technology, with the suggested solutions, can serve to improve the work process and increase the perceived customer satisfaction

6 Conclusion

This thesis set out to explore how an organization, through mobile technology, can increase the efficiency of its work processes and thus improve the perceived customer satisfaction. In order to do so, we conducted a study at Volvo Penta using a design science research approach. In our study we have shown three requirements based on the problems and strengths in the current work process. These three requirements have explored how to save time in the organizations work process and thus increase the efficiency. The time is saved with the help of a smartphone application. We have discussed around the benefits for the customer and his perceived satisfaction. The discussion is based around the increased efficiency and the implementation of a smartphone application.

The main concerns related to this study, and what some researchers have pointed out, is that today's smartphones have limited screen size as well as battery life which could be a drawback if one is to relay too greatly on them (Siau and Shen, 2003). On the other hand, since the work environment of the repair shop includes small and tight places as well as unhandy positions, a good solution is small devices that does not hinder the user to perform his job.

Furthermore, according to the requirement *Efficient resource allocation*, which eliminating the daily meetings entirely from the repair shops work process, the staff might run into a situation observed by Viehland and Yang (2007). They saw a problem where staff at a company that started to use mobile technology to decrease the need for meetings resulted in that the staff "complained" that they did not have enough face to face communication with their colleges. Now this was observed at a much larger organization where the staff that started to use mobile technology almost entirely stopped the face to face communication with fellow staff, which is unlikely to happen at the rather small repair shop where CroKuS would be used.

Additionally, when introducing changes into an organization there is always a risk of the staff opposing the changes. According to Kotter (1995), 50 % fails to introduce changes since they underestimate how hard it is to get people out of their comfort zones. Since our proposal for solution relies on the technician updating the status of the work order through the smartphone, they have to take on new activities in their daily work. Furthermore, the average technician is in his 40's and might lack a strong IT background which could limit the efficiency that CroKuS aim to bring into the organization. Additionally, new changes could make some staff less motivate to embrace the changes and strive to keep the old way of working (Ciborra, 1997).

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Appendix A

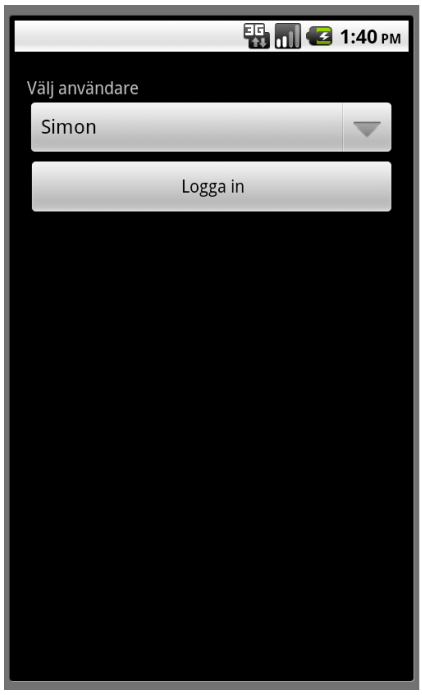

Figure 1: Screenshot from CroKuS, ie. the log in feature

Figure 2: Screenshot from CroKuS, ie. work orders are assigned to a specific technician (the one who logged in)

Figure 3: Screenshot from CroKuS, ie. the feature of reading error codes