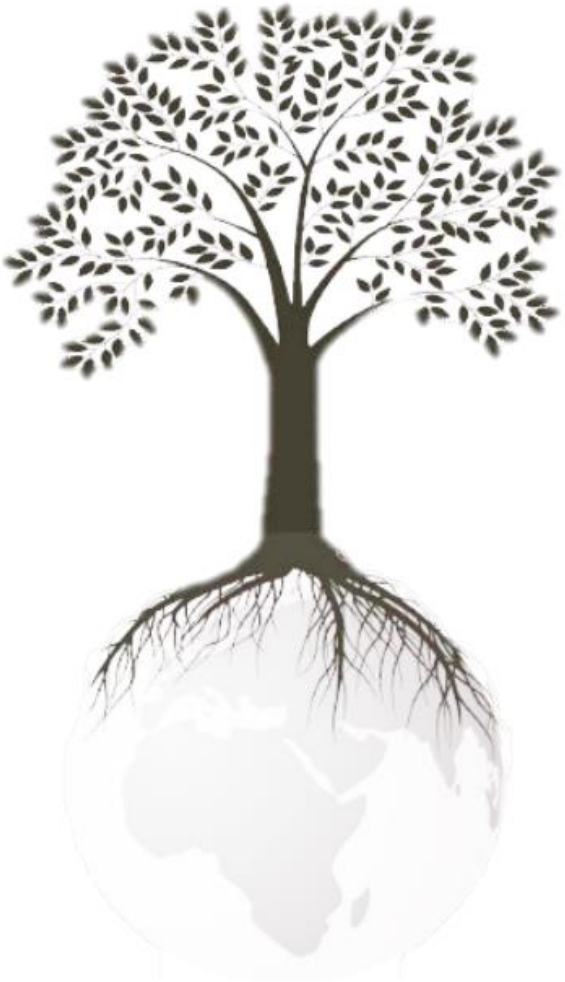
A digital solution

SSL



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1. Introduction

Existing research within modern science has sought to examine the benefits of interdisciplinary teamwork, in which scholars from various disciplines work together to address complex and ambiguous research questions (Cermak & Walker, 2012; Chettiparamb, 2017; König, 2013). Given the benefits appraised to interdisciplinarity, this report seeks to investigate how this approach can be utilized to create value for businesses. Furthermore, this report will critically reflect on some of the implications connected to this style of work.

2. Problem

To examine how the principals of interdisciplinary teamwork can be utilized to generate value for businesses, the forthcoming research will be grounded in a specific case: The voluntary food waste organization 'Stop Spild Lokalt' (SSL).

SSL started as a simple project with the mission to share leftovers and excessive food with people from the nearby community via social media. Over time, due to high demand, the mission of SSL has expanded, and has today partnered with supermarkets across the country with the purpose of collecting their excessive food, distribute it, and thus reduce food waste. Today, SSL is present in over 100 Danish cities and the 12 tons of food they collect is distributed from their nine 'Madoaser' (food oases) (Stopspildlokalt.dk, 2016). The operational part of their business is primarily run by their volunteers; This includes picking up food at local supermarkets, registering and organizing it in the nine oases, and handing it out to people who stop by the oases. According to SSL, the food registration process has turned out to generate several challenges, given that this process is carried out manually by writing the information in notebooks. Consequently, this process results in errors, miscalculations, and occasionally loss of valuable data, which can't be retrieved by e.g. managers. Moreover, this process does not allow for the exploitation of data for future analysis and predictions. Accordingly, improving this task is of high importance to SSL, not only due to the above, but also due to the legal requirements from the Danish Veterinary and Food Administration.

2.2 Problem Statement

How can the use of interdisciplinary principles be utilized to develop a digital registration solution for Stop Spild Lokalt?

According to Ragowski et al (2000), "information systems are vital to the operation and management of every organization" (Ragowski et al, 2000: 303), as such the above problem was selected to provide SSL with a solid foundation for running their voluntary organizations. By providing such a foundation, we believe that SSL will have a better basis to grow their business in the future.

3. Process

3.1 Data Collection

To examine the problem statement presented above, it would be evident to include the volunteers and managers at SSL throughout this research project. As IT design within any given organization usually entails the design of solutions for *"complex organizational structure, including several management levels, diverse professional groups, workplace cultures, and established working relations where new IT projects challenge the established ways-of-working"* (Bødker et al., 2011: 115). Thus, participatory design would have been the preferred method for data collection.

Although, due to the limitations and restrictions to gain access to SSL, such research was not possible to carry out. To mitigate the consequences of this constrain, secondary imperial research conducted within the field of voluntary work will be applied. According to Musick and Wilson (2007), voluntary work can be defined *"as when a group of people work together to achieve a common goal, such as digging a well: organizational participation and self-governance, as when people contribute time to maintaining an organization […]" (*Musick & Wilson, 2007: 11). This definition correlates with the organization of work at SSL and thus offering a good basis moving forward.

3.2 Common Goal Definition

According to König (2013), interdisciplinary experience and evaluation recommends the facilitation and enabling of a shared goal definition. Accordingly, we devised the goal of this research in collaboration:

"Utilizing interdisciplinary principles to examine the root cause of the presented problem and develop a digital solution for Stop Spild Lokalt"

After the articulation of the goal, we each chose to explicitly articulate our understanding of it and thus highlight incongruences, align mental models, and expectations to reach the shared goal.

3.3 Framework/Structure

Our structure is inspired by, and draws upon, the utilization of agile methods and user-centered design approaches, as recommended by Beyer (2010). The user-centered approach was chosen due to the complexity of SSL's organizational structure. And the agile method was chosen due

to its *"emphasis on rapid, iterative development along with minimal upfront documentation and design"* (Bødker et al., 2011: 1). Mainly, we were inspired of several principles within the Scrum software development approach, as this approach is a higher-level framework:

a) We devised a high level and flexible plan to reduce waste of time.
b) Our group met every week to discuss progress and modify requirements.
c) The meetings were conducted face-to-face to optimize time and minimize miscommunication.
d) We worked as *one* team with equal roles for all team members.
e) We provided each other with ongoing feedback on deliverables to ensure that valuable feedback was incorporated into the project straight away.

(Beyer, 2010)

4. Project

4.1 Current process

According to SSL:

- Volunteers register date, food supplier, food type, amount received, expiration date and production date.
- Volunteers are on different technical levels.
- The food registration process is a time-consuming manual process.

In addition to information provided above, we assume:

- SSL management picks up journal once a week to create overviews of the registered food.
- SSL has the financial capacity to provide each food oases with the recommended digital solution.
- SSL understands how to handle sensitive information's which might be shared externally with public organizations.

4.2 Problem Scenarios

Problem scenarios are good at visualizing key issues within a specific process (Rosson & Carroll, 2009). To gain a comprehensive understanding of the problem we created three problem scenarios (see table 1; see appendix for full overview), since this is a tool used within two of the disciplines that are represented in our group. This let us to a noteworthy interaction within the group, since we all have different ideas and perceptions of how possible issues might occur during the registration process. This provided the opportunity for us to "use the materials and skills at hand creatively instead of asking and waiting for money and future skills" (Cermak-Sassenrath & Walker, 2012: 4) since we divided the tasks and then afterwards debated on how the different scenarios should be constructed. According to Musick and Wilson (2008) volunteers are usually people who are extroverted, empathic and motivated by the feeling that their work will serve others need. Our problem scenarios are therefore constructed on this basis and information provided by SSL.

Problem Scenario 1: A SSL Volunteer
Frederik is a 26-year-old master's degree student from KU. Frederik is an environmentalist, who is very active within environmentalist communities, where he helps manage different social media accounts that inform about ways to reduce Co^2 emissions, recycling, waste reduction and more. Furthermore, Frederik is a volunteer at the local food waste oasis owned by SSL […]

Table 1 – Problem Scenario

4.3 BPMN Process Diagram – As-Is

Business Process Model Notation (BPMN) was chosen to provide an overview of the current process (Recker et al., 2012). We chose to create a BPMN, to create a foundation for a common understanding and hereby visualize a diagram representing the business design for SSL. The BPMN (see figure 1) gives an overview of the manual registration process that SSL currently is taking use of. Since all three lines of study uses different tools to visualize the process, it became clear how interdisciplinary culture appears within our group work (König et al., 2013). It became clear, how different approaches on strategies, methods and tools, are overlapping each other cross the different lines of study. BPMN has hereby, among others, been a tool where we were reminded how important interaction and learning processes are for the process of creativity and the creation of an inspiring and motivating environment, within cross disciplinary teamwork (Cermak-Sassenrath & Walker, 2012).

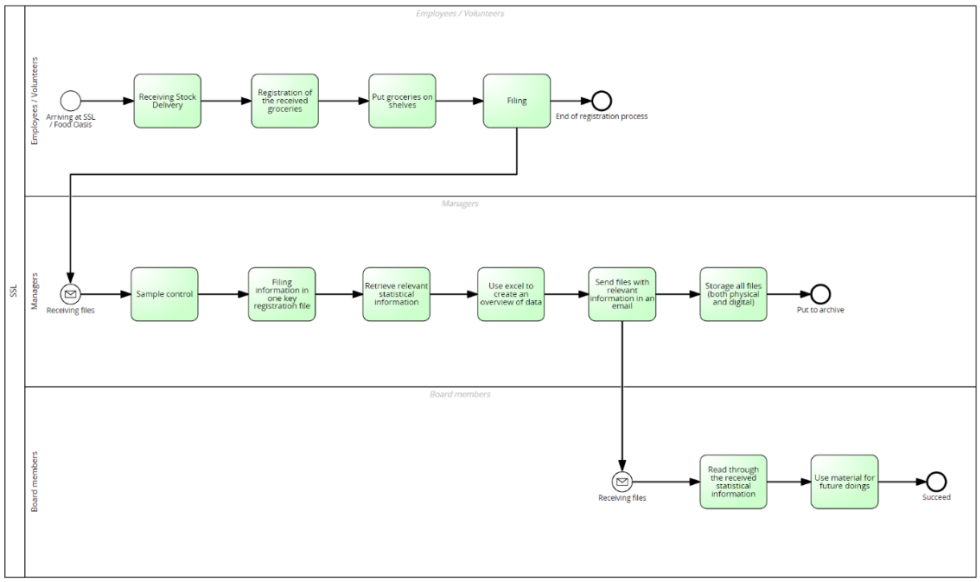


Figure 1 - BPMN As-Is

4.5 Summary of Pain Points

Altogether, the problem scenarios and the BPMN revealed a number of pain points with SSL's current registration process:

- Registration of food by pen and paper is time-consuming and allow more errors to occur.
- Data is recorded in an unstructured manner, since there is no database to secure the registration files.
- Collecting data is time-consuming, as this requires physical pick up at each oasis.
- Gathering data in one excel sheet is time-consuming, due to the unstructured manner of the data.
- Lack of instant access to relevant information, as this is stored in local notebooks and on locally stored excel sheets.

5. Product

5.1 Reflection and solution points

Our solution seeks to meet the problems occurring in SSL. By that we identified five solutions points to:

Solution Points	Pain Points
Effectively handle registration of food	Registration of food by pen and paper is time-consuming, and allow more errors to occur
Digitalisation of the process – Securing data via backup	Data is recorded in an unstructured manner, since there is no database to secure the registration files
An efficient registration tool, which allows employees to extract data without physical pick up	Collecting data is time-consuming, as this requires physical pick up at each oasis
Get an overview of food statistics	Gathering data in one excel sheet is time-consuming, due to the unstructured manner of the data
An efficient registration tool, which allows employees to extract data without physical pick up	Lack of instant access to relevant information, as this is stored in local notebooks and on locally stored excel sheets

Table 2 – Solution Points

We approached this by using each other's interdisciplinarity, since this allowed to draw on capabilities that enable us to see the problem from various perspectives. As defined by Chettiparamb (2017), the practice of interdisciplinarity makes it possible for a group of students, to change their major field without losing time. This became apparent for us, as we were "invited" into each other's knowledge space, and thus understand the connection between the different fields.

5.2 Activity Scenarios

To make our solution transparent, we chose to create three activity scenarios in correspondence to the problem scenarios. This made is possible for us to visualize what needs to be done to

improve the current process at SSL (see table 3; see appendix for full overview). The activity scenarios provided an understanding of how the solution could be like in a real-life scenario in SSL, which enriched the understanding of the solution.

Activity Scenario 1: An SSL Volunteer
Frederik is a 26-year-old master's degree student from KU. Frederik is an environmentalist, who is very active within environmentalist communities, where he helps manage different social media accounts that inform about ways to reduce Co^2 emissions, recycling, waste reduction and more. Furthermore, Frederik is a volunteer at the local food waste oasis owned by SSL […]

Table 3 - Activity Scenarios

5.3 BPMN Process Diagram – To Be

In order to follow up on our created BPMN of how the existing process is today, we discussed and developed a digital solution for how the registration process could be optimized. Hereby a visualisation of our suggestion for a future business design for SSL has been made, in which an app will support their registration process (see figure 2). This visualization was made for us to accomplish an agreement on how our solution should work in order to provide help for employees and volunteers at SSL. This solution includes less physical paper notation and registration, as long with shared files through an application on digital devices connected to SSL.

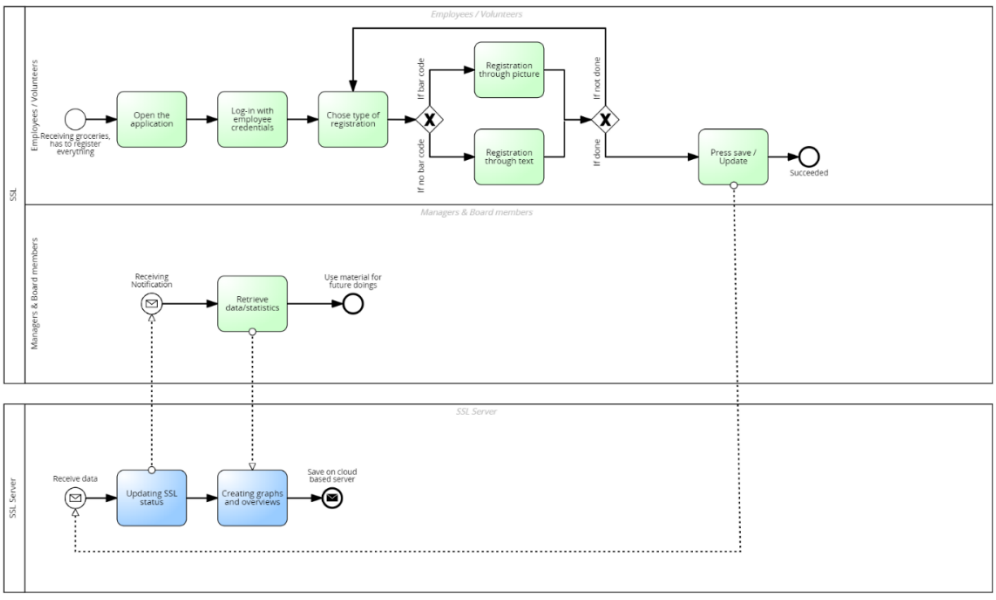


Figure 2 - BPMN To-Be

5.4 System Description

The system will consist of a mobile application used by volunteers and employees of SSL which main goal is to store and allow a better workflow during the food scanning process. The main system will consist of the collected data, the server API, and the mobile app for iOS/Android platforms. An easier registration is achieved by an intuitive app where the user can understand and use the mobile app immediately — that is, without consciously thinking about how to use it. Following material design patterns and the use of dropdowns and preselected data in the form, the user can register food faster than repeatedly handwritten all the food information that SSL should keep track of. This system's objective is not only focused to register the received food from its providers. Because this app offers a link between developer and the information system (backend) where data can already be stored in a digital system. The current system aims to provide a first set of tools to SSL to perform some analysis over its data to improve their resource management and minimize the error and time while searching on their history.

To determine systems behaviour and functionality, functional and non-functional requirements were captured and documented (full overview see appendix 3) after a feasibility study towards the project goals. We believe software requirements represent an important part of systems documentation. They reflect what is desired and expected form the system in an understandable way for all members of the team and different stakeholders.

5.4.1 Context diagram

In the Context diagram, we show how the system relates to its environment sub or integrated systems and actors (Bass et al., 2003: 372). The current Context diagram shows internal components of the system and actors involved and how do they relate to each other. Everything outside the "Internal" box, is the external environment that contains external elements, like mobile phones, that interacts with the system. This method was selected, as it allowed everyone in the team to better understand the technical overview of the proposed system and a basis to develop the prototype.

List of stakeholders/target group who would use the provided solution:

- SSL Volunteers
- SSL Managers
- SSL Board Members

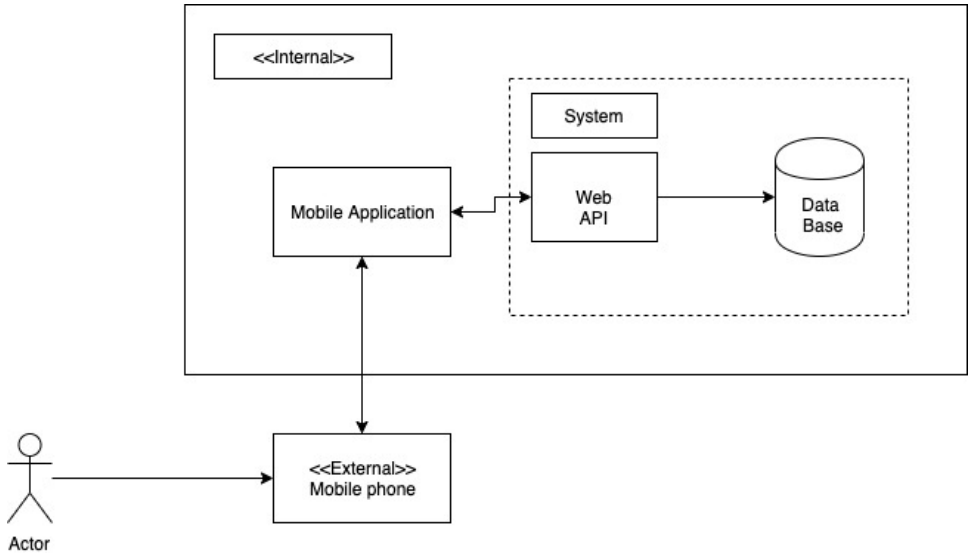


Figure 2 – Context Diagram

5.5 Quality attributes

As it is explained by Bass et.al (2003) quality attributes are property used to measure and test the system and how much does the system satisfy stakeholders needs. As team, we realized to extracting those quality attributes is a technique that compliments the created activity scenarios (cf. 5.2 Activity Scenarios). We proceeded to apply this technique because it gave a more technical overview of how the actual solution is being implemented and considered in the actual prototype.

These quality attributes have been extracted after applying the Quality Attributes Workshop. Where each member of the group represented a different stakeholder of the system and listed their expectations of the system. After an analysis the more important ones are extracted and represented as scenarios.

5.5.1 Quality attributes scenarios

These quality attributes scenarios have been extracted after applying the Quality Attributes Workshop. Where each member of the group represented a different stakeholder of the system and listed their expectations of the system. After an analysis the more important ones are extracted and represented as scenarios – *(to get a full overview see appendix 5).*

Scenario(s):		Volunteers working every morning registering the food received from the partners.
Relevant quality attributes:		1. I want to have a less tedious and faster food registration process.
Scenario parts	Source:	Volunteers
	Stimulus:	Desire to retrieve register large amounts of food in a short period of time.
	Artefact:	System
	Environment:	Food registration process
	Response:	Registration form in an APP so instead of handwriting there is a form with autocomplete functionality.
	Response measure:	Registration should take less than 30 seconds.

6. Prototype

In the creation of our prototype we sought out to meet the specific requirements in SSL. Prototypes are recognized to be a common practice to express design for computer artefacts (Houde & Hill, 1997). In the process of creating a prototype there are multiple perspective you can work from. These are well defined by Houde and Hill (1997) in which they have created a triangle. Each corner in the triangle represents a dimension, which the designer can explore. For our prototype we have focused on the prototype's role in SSL. We try to define which role it will play in the user's life, and how this can efficient their workload. In participatory design within information systems development it is described how you can divide an IT project into a design and implementation project (Bødker et al., 2011). The IT-design project must lay the foundation for deciding how to undertake implementation project and define the problems, clarifying goals and outlining solution.

In the process of prototyping, especially the fields of computer-science and design draw on each other's competences and used each other's inputs in the creation of the prototype. Hackman argues that groups who does not achieve the ability to include each other's expertise and effort, can result in groups may "burn itself up" (Hackman cited in Crow and Pounder 2000: 218), which clarify that the teamwork was performed correctly with room for inputs and collaboration.

The result of this collaboration ended up on implementing the mock-ups of the prototype. Designed by the extraction and analysis of the solutions requirements and transforming those requirements into User Stories. Which later allowed an easy control and management of their state by defining their subtasks.

6.1 Prototype Explication

The mobile app has been build using react native. React native allowed us to build components, Android and IOs UI native elements, using the same code. This decision has been made in order to provide SSL with a solution where one developer can maintain both codes. The internal system consists of a Node.js server. The server has been developed using GraphQL as a layer of interaction with the database. GraphQL allow to aggregate data from multiple models, distribute it upon multiple platforms, and plumb it into an app's UI. As a company which didn't have a digitalised information system. GraphQL would allow a high flexibility to SSL to start analysing an "play" with the data.

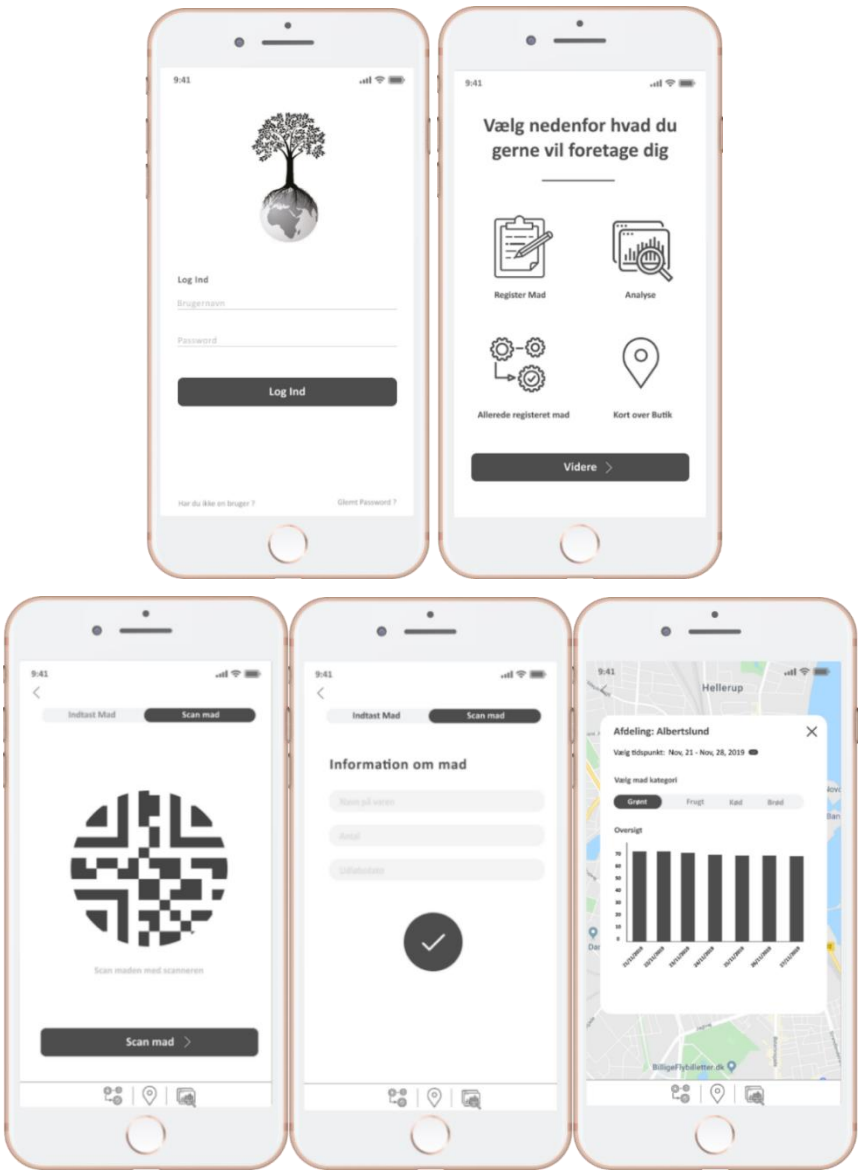
The protype has been deployed into two different sites:

- The mobile app in expo.io
- The backend service in heroku

For more detailed explications of how to use the actual prototype enter into: https://github.com/AlbertLlebaria/CrossDisciplinary_Course.

6.2 Mock-up

As seen below we have created five mock-ups to compliment the coding process of our prototype. It has been created for us as a cross disciplinary group to understand and test the product more efficiently. Furthermore, it has been made for us to easier change the product if future research requires fundamental changes. The mock-ups visualise how volunteers and employees at SSL will see the different possibilities in the application:



6.3 Testing

According to Beyer (2010), involving the direct end-users at the end of the design process is important, to secure that the solution meets its intended purpose. Given the constrain presented earlier in this report, it was not possible to test the prototype on the target group. First, we considered testing the prototype on users that might represent the end-users but refrained from this as "surrogate user's may not actually represent real users, and marketing methods often do not collect design data" (Beyer, 2010: 3). As such, we recommend that further research should be conducted in the future, where the prototype can be tested in the environment in which it is intended.

9. Reflections

According to Gloor et al. “having a diverse mix of students’ disciplines and backgrounds on the teams ensures that there at multiple approaches of generating new ideas” (2016: 4). By harnessing the knowledge contributed from our different academic fields, we realized that our different approaches to the problem enabled us to build on each other’s ideas and expand our solution space. Furthermore, were able to generate and execute on ideas at a faster paste than usual and thus enhance our productivity (Rijnsoever & Hessels, 2012). E.g. once we agreed on the solution, Albert and Kasper from DDIT and CS easily draw mock-ups and develop a functional prototype. Had these resources not been available, Mathilde and Patricia from DIM would have had to outsource these actives. By working together, we were all able to expand our individual knowledge space, as each discipline provided tacit knowledge about certain techniques. In other words, by working together to solve this complex problem, we all got to add new skills to our individual toolboxes.

This report has throughout the process, further been revealing different pitfalls, but one has emerged more than others, and has affected the overall outcome. Our process began by including all our interdisciplinary skill set, why a lot of different tools, methods and approaches were taking in use. This led to a struggle rather late in the process, as we had to incorporate a lot of different elements in the report.

As of our eager to use tools which compliment all three lines of study, we wanted to focus on more closed approaches as introduced by Aagaard-Hansen (2007). Despite a closed approach we acknowledge that “the choice of data collection methods often has a direct bearing on the degree of openness” (Aagaard-Hansen, 2007: 427). Because of the new founded knowledge, we all see the benefits of a further limitation in use of tools and how a combination of both open and closed approaches will result in a more balanced suggested solution.

It is certain that without an initial introduction of we at the starting phase of the project, where each team member gave and introduction of themselves, together with their initial perspective of what is cross disciplinary work, it may have led to chaotic and tedious work. This helped us to understand each other's strengths, so different potential and skills among team members were crossed between disciplines, and more importantly a common goal. We believe that defining a common goal is an important step in an interdisciplinary project so a common language between team members is grounded.

9.2 Individual reflections

9.2.1 Student No. 16445, Albert-Jose Llebaria Holda

As the computer science member of this interdisciplinary team, I contributed with the development of the prototype and worked directly in the whole process of the project, from the problem statement til the actual prototype. During this project, I learned from my partners' knowledge and experience, which would not have been necessarily the case if I had worked as a normal developer in a large company. This provided me with a valuable learning experience and improved my understanding of other disciplines roles and tasks within a project.

Because one of our common goals within this course was to take profit of this interdisciplinary experience to improve our understanding of different methodologies and approach between disciplines. As a computer science student, I tried to share how would be the approach and process to implement a solution from a software team perspective by applying techniques learned at Software Architecture course from past semester and my career as a fullstack developer on different projects. Explaining and applying which are the main necessities for software developers to implement a solution, our methodologies to describe a problem - in this case, I proposed quality attribute scenarios. Together with the reasoning behind the analysis requirements and how those are transformed into stories for later implementation together with the documentation of a technical report.

During the initial steps of the project, after declaring our common goals and knowing each other skills we proceed to extract what problems is SSL struggling from the initial meeting with the board members. At this stage, no struggles were found, and I could already notice the benefits of having a cross disciplinary team from the creativity aspect. This was noticeable in the brainstorming process, where we improved each other ideas by giving feedback and providing concepts from our respective disciplines. However, on the project and process steps, I felt some of the challenges from cross-disciplinary projects stated by Aagaard-Hansen (2007). From my point of view, I believe the terminology was the most noticeable challenge, where same terms within different disciplinary discourse had a slightly different meaning. The scenarios are the most observable example of how we had terminology challenge and we confront it and approached it into an interdisciplinary way.

My understanding of a scenario is more a technical way to detect how to approach a necessity, which artifacts are related to it and how is going to dealt and measured. Whereas the DIM

approach for example is a way to illustrate the problem and give an understanding of what are the necessities of SSL in this case. However, we could overcome this problem by gaining mutual knowledge of this difference within this term and combine both methodologies. The CS quality attribute scenario in 5.5 approach was implemented after 4.2 problem scenario, taking 4.2 as a reference for the quality attribute workshop and then for the quality attribute scenario.

It is certain that a good communication and management in an interdisciplinary project is crucial to have a good achievement of it. A special mindset needs to be settled between the team members. Team members of an interdisciplinary team must be ready active on the different types of learning strategies that occur during the project. I would say this mindset is like the one that an employee needs in a start-up. Where there is almost a total freedom to apply any technique or process in order to achieve an objective and the collaboration between the members of the project is close. Narrowing the bridge of cognitive domain to a common awareness of the needs at that moment and cooperate on tasks from the other disciplines. I believe that the fact we followed an agile methodology for our organization, helped the fact of effective cooperation between team members and awareness of the current status of the project for a reactive and efficient response.

However, regardless of all the benefits from having an agile methodology to plan and work during the project and a good definition of our goals and a project contract. I felt that a better role statement of everyone was needed. The Competing Values Framework illustrated in König et al 2012, could have helped to setting up a better structure to maximize our output. I believe there is a need of clarifying some of those roles during a project. This way each team member has a better understanding of their responsibilities within the project and our decision making would have been more accurate. I felt that someone had an equal role in the project some decisions took more time. The fact that we didn't know each other's personality and way of working slowed down the statement of the roles in the project. Thus, some decisions in the process took longer that it would have been with some leader role or facilitator.

After this project, I feel I gained a better perception of which should be the initial steps of the project, and how to approach them in a less technical way. Accomplishing one of my personal goals of improving my organization skills and management resources regarding to how a project should be approach in a more ''business'' way. If the project would have been formed by only computer scientist. We would have approached to the problem by starting to implement

the code, arguing which framework or technology we should while having vague idea of the current requirements or what is exactly the solution. I believe the fact of working together with 2 DIM students really helped me to accomplish this. I reinforced my knowledge and perspective of how a project life cycle is and the different mindset and approaches that one needs to have during those. Right now, If I would have to start a project, I would put away the technicalities. Focusing to first understand the problem, it's scope, extract properly the needs of the stakeholders so an accurate solution statement can be done so then we proceed to extract the requirements. I got a better understanding that intense research must be done before start thinking of systems architecture and that there is an adequate time for each discipline to perform and importance during the project life. As a computer scientist student, I would always focus on the perfection of the code and not focus on the quality of the clarification of the problem. However, this interdisciplinary experience has increased my awareness during the different steps of a project.

I believe this project could have received more benefit from interdisciplinary team If we had more time and resources in this project. It could have been different if the project had been different and we had more time to implement. As it is stated in Aagaard-Hansen (2007), *"there a long-time perspective for cross-disciplinarily to succeed"* and it could take several projects so interdisciplinary benefits can be fully achieved. Also, the vague interaction from SSL in the sense I felt they were too comfortable with the management of their organization and how they are fighting against food waste. This was a drawback for the creativity output and motivation of the project. However, I think that the amount of work done in this project would have been able without an interdisciplinary team.

9.2.2 Student No. 15311, Kasper Høxbroe Jeppesen

In the project, there have been exciting discussions that allowed us to understand each other disciplines and how to collaborate. Our different perspectives and knowledge let me understand how different people approach different problems, and how they decide to solve them. A goal for me was to understand computer science at a higher level and to understand the mindset of a student from computer science. Because of the way I have had structured my third semester and the learning outcomes I wanted, the collaboration was something I could use outside the cross-disciplinary teamwork.

One of the first steps in cross-disciplinary team-work is to obtain mutual knowledge (Aagaard-Hansen, J. 2007). This was an essential part for us at the beginning, where we tried to map out each other strengths and understand what area we could create the most value each of us. This also gave an understanding of where we may be overlapping in each other competencies. From my perspective, I added Design - Thinking, Process, and research (to understand the users, collect data, Visual Design, Testing, Interactive prototyping). In this process, I learned that another group-member also had design skills and the different methods the group member new off were sometimes different to mine. This is also described by Aagaard (Aagaard-Hansen, J. 2007), where knowledge about alternatives solution can give another perspective on your way to think, which can be very healthy. One method from my discipline, which is essential, is the research. In a design-process, almost 50% is research where you must understand the field and generate insights to base your ideas on. It was rather challenging to get in contact which the relevant staff from SSL, which made it very difficult to perform this kind of research. If I were to do a similar project in the future, this was a method I would have had performed more of in the project, since It is a crucial step in the creation of a design-project.

One key element from the design process that I believe could have been interesting for us to incorporate in the end, would be a more participatory approach. The approach focusses on incorporating people with no design skill in the process. Instead of sitting in an isolated area, developing the idea, you seek out to develop a space where the customer does not become the customer, but codedesigner. (Kolko, J. 2018). The reason for this could have been an interesting method to use in together with SSL, is because it would have allowed to understand their needs on a much higher level. And get their thought on the prototype and if we were working in the direction that match the need of SSL. This could have been done throughout different kinds of workshops, where SSL could come with suggestions to the product. This would have let us use

cross-disciplinarity with the organization where we use their competences to understand the problem and how to generate the best idea.

An exciting way to conduct a workshop with SSL where we connect participatory with cross-disciplinary would be by creating a 3-phase workshop. The first would be by brainstorming, which is one of the most widely used methods for generating ideas in a short time (Löwgren & Stolterman, 2004). By utilizing a brainstorming method, participants will be able to give us an idea about what thoughts they have when opportunities and challenges are mentioned. It allows us to compare with the problems and solutions we have identified. In the brainstorm session, you ask all participants to write down an idea on a post-it note, at least once every 30. second, for five minutes, allowing for ideas from a range of different perspectives from people with different competencies.

The second phase would be creating a reflections-circle where the purpose of this exercise is to open up a conversation based on the possibilities and challenges that were generated during the brainstorm. In the exercise, participants must take each opportunity and challenge up for discussion and consider from a circle, where the further in the middle the post-it would be, the more value the idea could create. The point of the above process is to open up the thinking about the organization and allowing for discussion and using each other competencies to find the most relevant ideas that would help the process.

The third phase would be to sit all participants around a table. Each participant would be given a table with 16 felts, where they were to write down four ideas for concept proposals in five minutes. The ideas could both be from the previous exercises or be completely new. After five minutes, where each participant would have written down the four ideas, the paper was would be passed on to the person on the right. This person would now have to work on these four ideas in the next felts and give his perspective. The rotation could happen every five minutes until all participants had been in over everyone's thoughts. The goal of the exercise is that each idea views the ideas from multiple angles. In addition, we get more creative inputs, and the participants would be allowed to unfold in a way that would not be applicable if they were alone with the development of ideas. Thus, the risk of creative is reduced barriers that can be experienced when creating an idea (Löwgren & Stolterman, 2004). The workshop would allow us to use SSL in a cross-disciplinary approach that go beyond the cross-disciplinary team-work in our group

In the sense of using statistics for SSL, it is essential to understand the audience, as this will help you know what data is the most valuable to communicate out to the organization. This is both about understanding the actual needs of the audience but also which kinds of graphical material that appeals the most compared to what you wish to communicate. To help understand how the visualizations should be presented to SLL, a purpose map is a helpful tool to know how to talk to your audience. The visualization should assist the viewer in understanding the data and drawing as much meaning out of it as possible, so they can make a decision based on that information, while you as designer highlight key insights. (Kirk, 2016). Reflection more on the process on using statistics, we could improve the way we would present it to them, where different kind of prototypes could be incorporated in a workshop with SSL.

Many interesting discussing have occurred in the project, but it can still be argued that we did not incorporate enough of each skill-set in the project. This is due to the case partner and the frames surrounding the project, where the guidelines were sometimes challenging to understand. What is meant is when the access to the organization is limited, it affects the whole process — both in terms of motivation and creativity. But the personal experience has still been good. The highlight of having collaborations is when you as a team, can divide tasks that you are not capable of making yourself, to the people with the competencies. I believe that was an ability we were good at within our teamwork, which let us follow a plan and stick to it. We trusted each other skills and believed when a person was to deliver a task; this task would also be delivered within an expected quality range.

The cross-disciplinarily has been good within our group, where learning from each other abilities will help us in further collaborate with other people. This will be helpful when we, in the future, must work with different disciplines to reach a common goal in a project.

9.2.3 Student No.16601, Mathilde Fynbo Andersen

To work interdisciplinary gives great opportunities to discover each other's strengths and weaknesses, but most interestingly, interdisciplinarity creates a process with knowledge sharing which ends up strengthen the individual knowledge and disciplinary background. The interdisciplinary field is a field which has become coveted in a large number of research fields (Raasch et al., 2013). When beginning the project of Cross Disciplinary Teamwork, this interdisciplinary approach was something I already tried in previous projects. Therefore, I entered this process with the perception of how interdisciplinary teamwork affect the interdisciplinary process and individual background of each team members throughout the process.

Throughout our first meeting as a cross disciplinary group, a lot of different ideas for a project was given, and each of the different suggestions were influenced by our own disciplinary background, but most interestingly was, that they all contained elements that could be applied for one of the others disciplinary backgrounds. I found it interesting how we cross DIM, DDIT and CS could brainstorm without any larger scaled issues. This was due to our different knowledge within both our own research field and the others; for example, I am a DIM student but are currently specialising in service design (which aligns with DDIT) and has previously been programming (which aligns with CS). During this part of the process, we had a hard time localizing the direction of the project, as we were not confident on the aim of our final product. According to Aagaard-Hansen, are there two motives for doing research within a cross-disciplinary field, "either to provide results that can be applied or as a source of inspiration for new, overarching research questions and exchange of methods and conceptual frameworks" (2007: 426). The first thought was that we should create results and hereby take advantage of the different disciplinary backgrounds. But throughout the process, we came to realize that for this project the most comprehensive outcome has been the knowledge sharing and the exchange of methods, framework and academic sayings.

The two motives provided by Aagaard-Hansen (2007), seems coherent throughout the research of cross-disciplinary teamwork. Raasch et al. raises the question; "Do scholars from different disciplinary backgrounds jointly solve the puzzles of the new research field, or do they mostly co-evolve their understandings without tight integration?" (2013: 1138). For me as a business student, I alone would not have been able to jointly solve the provided puzzle and hereby create a result which immediately could be applied. Partly because of a limited tool set, and partly

because of the missing ability to create the actual prototype that we wanted to provide SSL with as our solution. Therefore, I would argue that I as a business student tend to focus more on the problem itself and implementation rather than the actual product.

9.2.3.1 Cognitive difference

Throughout the process, all team members contributed with different tools, such as method, theories, analysis, etcetera. In our group we were two DIM students, which opened for different discussion on which methods to use within a business and management point of view. I believe it had a significant impact on the process and project that we were two students from DIM who could support, backup and confirm debates within theories and methods from a business perspective. To give insight in some of the elements that I as a DIM student contributed with for the ideation, is tools such as BPMN with To-Be and As-Is strategies. As described in the collective reflection, we discovered that we had a lot of complimentary competencies which led to a lot of methods complimenting each other. But as Nooteboom (2000) express, a long side having complimentary competencies there might occurs challenges within our cross disciplinary team due to our cognitive differences.

Within our group minor, but noticeable cognitive differences appeared. Therefore, we had an interest in reducing the cognitive distance by focusing on knowledge sharing a long the way "to achieve a sufficient alignment of mental categories, to understand each other, utilize complementary capabilities and achieve a common goal" (Nooteboom, 2000: 71). But even when trying to use our knowledge around cognitive differences and be open to cognitive diversity, I as a DIM student took for granted that both DDIT and CS students would know the phrases As-Is and To-Be. This unshared knowledge got debated in the very end of our process, which made us be critical about our thoughts of openness to cognitive diversity; we needed to consider if there were other used phrases that might had been misunderstood or not understood at all. Through debates our behaviour within the group is stimulated by our cognitive difference and disagreements (Mitchell et al., 2009), but after given insight and share knowledge about how and why I as a business student use it, we chose to keep it in the project outcome. Thus, this debate went over to be a part of openness to cognitive diversity, since we within the group all wanted to gain knowledge from each other's interdisciplinary backgrounds and hereby engage to dialogue. "By encouraging frequent discussion and task contributions, openness to cognitive diversity prompts members to express their divergent viewpoints and fosters a willingness to debate" (Mitchell et al., 2009: 538). All these outcomes from our debates are highly beneficial to my disciplinary background, for both knowledge regarding tools, methods

and theories but also for me to understand how I forthcoming should express myself when working within cross disciplinary teams and cognitive diversity in projects.

As explained above, a lot of interesting outcomes, perspective and challenges appeared during the process, and I beforehand had the perception of how cross disciplinary teamwork and cognitive differences would have an impact. During the process it became noticeable how much CS differs from DDIT and DIM. For example, as a computer scientist you do not normally need to focus on practicalities such as methods and theories within implementation and design, a project would typically be the delivery of a successful product, and they will often work closely together with other team members who also have IT disciplinary perspectives (Pennington, 2011). Whereas the other way around, I as a business student do not need to focus on the technical background and prototyping, and normally works closely together with team members who has their background in either business and/or design while focusing on the problem. These differences affected the balance between our process and project, since "IT experts cannot understand the needs of the scientists – and scientists cannot understand what is even possible – without conceptual integration between the scientists and IT experts" (Pennington, 2011: 57). Keeping this in mind from the beginning of our process, we were aware, that we needed to focus on a knowledge sharing process in order to get a good project. This resulted in a process with an open debate at every group meeting which allowed us to investigate the unknown and get an engaged debate about everything from practicalities such as report setup, to methods and theories to use, to the actual prototype and its design. I will therefore for future projects, keep in mind the key challenges from this project and how important knowledge sharing and openness to cognitive diversity are in order to make a groundwork for a good process and hereby a good project.

9.2.4 Student No. 16512, Patricia Namakula Mbabazi

As described in our group reflections above, working interdisciplinary allowed us to expand our solution space and generate ideas we probably wouldn't have been able to come up with individually. Although, our way of approaching our work, in which we let ourselves inspire by principals within the agile culture – e.g. working as one team and providing everyone with an equal role (Beyer, 2010), turned out to be a bit challenging. Our interpretation of this principal meant, that every week when we met to discuss the next steps, we would collectively discuss merely all project deliverables with the purpose of reaching a shared agreement on how to proceed. Such discussions, although conducted diplomatically and respectfully, could be rather time-consuming, and some of the issues we encountered, were similar to those described by Aagaard-Hansen (2007).

Terminology

Even though we all study IT, we realized that various terms used in all of our different lines of studies were used in different ways and severed different purposes. Consequently, this meant that the time spent on discussions during the process were about aligning understandings and reaching compromises as how to utilize a certain tool, rather than actually producing. One example was the scenarios. As DIM students we wanted to utilize scenarios as they are presented by Rosson & Carroll (2009), in which the provide rich, descriptive and detailed stories of IS artefacts in use cases. As DDIT students, the purpose of scenarios would be to provide a clear and short description of the usage of the IS artefact with the purpose of providing e.g. developers with a quick understanding of the purpose of the tool. In the beginning, as early mentioned we wanted to include scenarios in all the forms we knew, but quickly realized that this would be a time-consuming process, which wouldn't add more value to the project. Instead we did as Aagaard-Hansen (2007) suggests and tried to obtain mutual knowledge by gaining *"insight into the basics of methodology, theories, epistemological and historical aspects of the others' disciplinary discourse".* (Aagaard-Hansen, 2007, p. 432). As such, we proceeded with scenarios as they are taught on the DIM program. The argument here was that they provided the most in-depth description of the use case, meeting both Rosson & Carroll's (2009) objective as well as the objective by the DDIT discipline.

Competing Skills

Whether the above argument to proceed with the DIM perspective on scenarios was fair or not, is hard to say, but it made visible another challenge addressed by Aagaard-Hansen (2007) – *Power Balance.* Even though we aimed at working as one team and providing everyone with an equal role, unconscious competition between the different disciplines was unavoidable. It became apparent, that depending on the project stage of our project, one discipline had more status over the other disciplines depending on the strengths and weaknesses of the particular discipline. E.g. during the initial phase of our project, the DIM discipline was more dominant, as the discipline provides student with a strong basis for planning and structuring IT projects (ITU, n.d.). This included structuring the project into different phases such as current state (as-is) and the future state (to-be). The 'as-is' stage was carried out in a structured manner in which the current process in SSL was mapped out with a BPNM diagram (Recker et al., 2012) and scenarios constructed based on information provided by SSL and clearly defined assumptions about the organization. Although the content within the (to-be) processes was primarily dominated by the student from DDIT and CS, as they clearly had the knowledge and tools to deliver usable content in this area. Working in an interdisciplinary setting like this *"can [therefore] be seen as the potential battlefield of individuals as well as disciplines"* (Aagaard-Hansen, 2007, p. 431). Conclusively, it is difficult to determine, whether or not this approach is the best way to go about a project, in which the most knowledgeable discipline gets the final say.

DIM Contribution

The above presented challenges, combined with our way of approaching interdisciplinary work, made visible the role that a DIM student can take on in interdisciplinary teamwork, as well as the skills that I have gained within my own line of study. If teams are to succeed with interdisciplinary work, there is a need for *"coordination and management [which] has become an important task in interdisciplinary research collaborations and a key determinant of their success" (König, 2012, p. 1).*

During our project, it became clear how interdisciplinary work can provide a more holistic picture of a problem and the solution space. Although, without the right facilitation, the process became unnecessarily time-consuming, taking time away from the value-adding elements of interdisciplinary teamwork. Given the tools and techniques taught on DIM, which provides DIM students with a common language to communicate with different disciplines with the field of IT, there is great potential for DIM students to be the ones facilitating collaboration and

management in interdisciplinary teamwork. Such an indispensable facilitation role would then be able to tackle the challenges presented above by: a) Creating rules for cooperation and thereby manage time efficiently, b) manage heterogeneity and facilitate mutual learning to tackle e.g. terminology issues, and c) balance personal attitudes to reduce unconscious competition between the different disciplines (König, 2012). Furthermore, such a facilitation role would also be able to plan integration – more specifically, manage when to work multidisciplinary and when to work interdisciplinary.

In this particular project, in which the aim of the course was for students to work interdisciplinary and extract learnings from such a project and process, the time-consuming aspect was no problem. Although, in practices there might not always be time to conduct a project the way we did, due to dependencies, deadlines, and external factors which are out the control of the project. Therefore, it became quite clear, that it is important to select where an interdisciplinary approach adds value and when to combine this approach with other disciplinary approaches for the most efficient work process and project execution (König, 2012).

Given the fact that competition between disciplines can be a challenge in interdisciplinary team work (Aagaard-Hansen, 2007), it is important that the facilitator establishes legitimacy for taking leadership (König, 2012). This could e.g. be done by selecting a framework that supports an interdisciplinary approach and simultaneously reflecting the importance of a facilitator. This could e.g. be the Scrum framework, which is a software development approach in which roles are predefined (Beyer, 2010). E.g. the Scrum Master role, who *"co- ordinates a highly cohesive and committed team and ensures that the day-to-day activities of the team run smoothly" (Beyer, 2010, p. 1).* Thus, if legitimacy is not established, the facilitating role is in danger of being perceived as just another competing discipline.

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Appendices

All appendices have been added in the following pages. They consist of the following:

Appendix 1 – Problem Scenarios

Appendix 2 – Activity Scenarios

Appendix 3 – Functional requirements

Appendix 4 – Non-functional requirements

Appendix 5 – Quality attributes

Appendix 6 – Mock-ups

Appendix 7 – Sitemap

Appendix 1 – Problem Scenarios

Problem Scenario 1: A SSL Volunteer
Frederik is a 26-year-old master's degree student from KU. Frederik is an environmentalist, who is very active within environmentalist communities, where he helps manage different social media accounts that inform about ways to reduce Co^2 emissions, recycling, waste reduction and more. Furthermore, Frederik is a volunteer at the local food waste oasis owned by SSL. Frederik just arrived at the oasis. Usually, he arrives at the oasis three hours prior to its opening hours to conduct manual, administrative task. Another volunteer arrives to the oasis to drop off the food waste she has collected from various supermarkets. Once the food has been dropped off, Frederik starts registering all the food in a notebook. Here he registers the supplier, food type, amount received, food that can't be served etc. Frederik finds this part of the job boring, and consequently his sense of detail declines during the process, and his handwriting becomes sloppier. Although, Frederik knows that he can't skip this task, as the oasis may lose its license to operate, as it is required by the oasis due to compliance regulations set by the Ministry of Food. Once Frederik is done, he places the notebook on the top shelve, where and administrative employee will later pick it up. He then proceeds with presenting the food and preparing for the people who will come and collect it.

Problem Scenario 2: A SSL Manager
Anna is 46 and works as one of the few employees at SSL. She has an education focusing on food optimization and how this can create better processors in organizations. She was employed by SSL 2 years ago and has a primary focus on creating better internal structure in SSL for how to distribute the food. She has several different tasks daily and must keep track of the groceries. This is done through notebooks where employees register all the groceries when they arrive at SSL. It is problematic for Anna to have an overview of their inventory, because the written notes in the books are not always the same, and it can be difficult to find specific information back in time. The primary problem is the missing overview of their inventory. Two weeks ago, she got a task from the board where she must present an overview of how the food distribution has been in SSL for the past two months, and the 10 most relevant food types. To complete the task, Anna is facing difficulties in finding all the information in the notebooks due to missing data, data written differently and

lack of structure in the notebooks. Furthermore, she has to gather this unstructured data in an Excel sheet, which she stores locally on her laptop. This prevents her from delivering the presentation to the board.

Problem Scenario 3: SSL Board Member

Henrik is 55 years old and is a board member of SSL. For many years, Henrik has been a driving force in various organizations fighting for a solution of food waste. Because of this, he considers is position as a board member important as he believes SSL can make a difference for the future. Since Henrik has a degree in economics, numbers and statistics are very important to him as it helps to form an overview of an organization. Therefore, he wanted to get an overview of how the food distribution has been in the SSL for the past two months but has found that the registration of food in SSL, makes it difficult to get these data. He wants the opportunity to easily and quickly access this data every week to understand which further direction must be taking to further develop SSL.

Appendix 2 – Activity Scenarios

Activity Scenario 1: An SSL Volunteer
Frederik is a 26-year-old master's degree student from KU. Frederik is an environmentalist, who is very active within environmentalist communities, where he helps manage different social media accounts that inform about ways to reduce Co^2 emissions, recycling, waste reduction and more. Furthermore, Frederik is a volunteer at the local food waste oasis owned by SSL. Frederik just arrived at the oasis – an hour prior to its opening hours to register and prepare all the food for collectors. Another volunteer arrives to the oasis to drop off the food waste she has collected from various supermarkets. Once the food has been dropped off, Frederik starts registering all the food in a new app that SSL has recently invested in. The app enables him to either scan the food via a bar code or a photo scan, which utilizes artificial intelligence to recognize the food type. With the app, Frederik can register the supplier, food type, amount received, food that can't be served etc. at a fast paste, as he doesn't have to manually right everything down with pen and paper. Once Frederik is done, all the information he has scanned is automatically stored on a local server, allowing his manager to collect this information when needs be.

Activity Scenario 2: A SSL Manager
Anna is 46 and works as one of the few employees at SSL as a manager. She has an education focusing on food optimization and how this can create better processors in organizations. She was employed by SSL 2 years ago and has a primary focus on creating better internal structure in SSL for how to distribute the food. She has several different tasks daily and must keep track of the groceries. Luckily, all the information is available to her via SSL's new app, in which all data is collected and stored. Given her fast and easy access to data, Anna has the time to conduct extract reports, analysis and research during her working hours. Two weeks ago, Anna got a task from the board where she must present an overview of how the food distribution has been in SSL for the past two months, and the 10 most relevant food types.

To complete the task, Anna extracts and structures all relevant data from the local database where all data is stored. A couple of hours later, Anna has completed the analysis, which she forwards to the board in a power point presentation.

Activity Scenario 3: SSL Board Member

Henrik is 55 years old and is a board member of SSL. For many years, Henrik has been a driving force in various organizations fighting for a solution of food waste. Because of this, he considers is position as a board member important as he believes SSL can make a difference for the future. Since Henrik has a degree in economics, numbers and statistics are very important to him as it helps to form an overview of an organization. Therefore, he wanted to get an overview of how the food distribution has been in the SSL for the past two months. Henrik has via the new company app looked into some numbers and especially some numbers catches his attention, and therefore he emails Anna, a manager at SSL and asks her to conduct further analysis on the numbers. He receives the report a couple of hours later.

Appendix 3 – Functional requirements

Functional Requirements	**Description**
Record data	The system should be able to collect data
Employees should be able to search for information	To make the system more User-friendly and enhance the user experience, a search function is added.
The system should have a picture scanning function	When the employees scan the fruit, it will automatically detect the kind of fruit to create an efficient workflow
The system should have a barcode/QR scanner scanning function	
The system should have a log-in function	The user should be able to log-in to the system with their own account
The system should have a drop-down menu from where the employees can select the relevant distributor	The customer must write the distributor information, as this is not possible with the scanning.
The system should contain a calendar function, from which the volunteers can select the arrival date, and expiration date of the food	The customer must write the expiration date and arrival date, as this is not possible with the scanning.
The system must display the available food with its information	
The system must be able to modify the current amount of food	
Overview of categories • Frontpage	Login into the system, the user should have an overview of which functionalities

• Record history • Data for the day	
Employees should be able to pull records containing	
Filter function	• Food type • Date • Expiration date

Appendix 4 – non-functional requirements

Non-functional Requirements	Description
The interface of the app should be intuitive to navigate	So that the various volunteers can use the app, regardless of their technical acumen
The search function should be able to retrieve data fast	1-3 seconds

Appendix 5 – Quality attributes

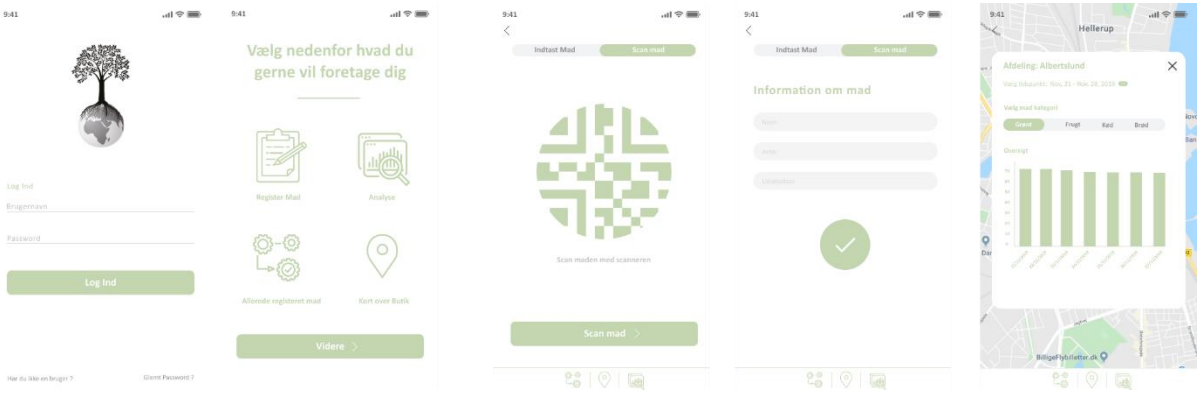
Scenario(s):		Volunteers working every morning registering the food received from the partners.
Relevant quality attributes:		1. I want to have a less tedious and faster food registration process.
Scenario parts	Source:	Volunteers
	Stimulus:	Desire to retrieve register large amounts of food in a short period of time.
	Artifact:	System
	Environment:	Food registration process
	Response:	Registration form in an APP so instead of handwriting there is a form with autocomplete functionality.
	Response measure:	Registration should take less than 30 seconds.

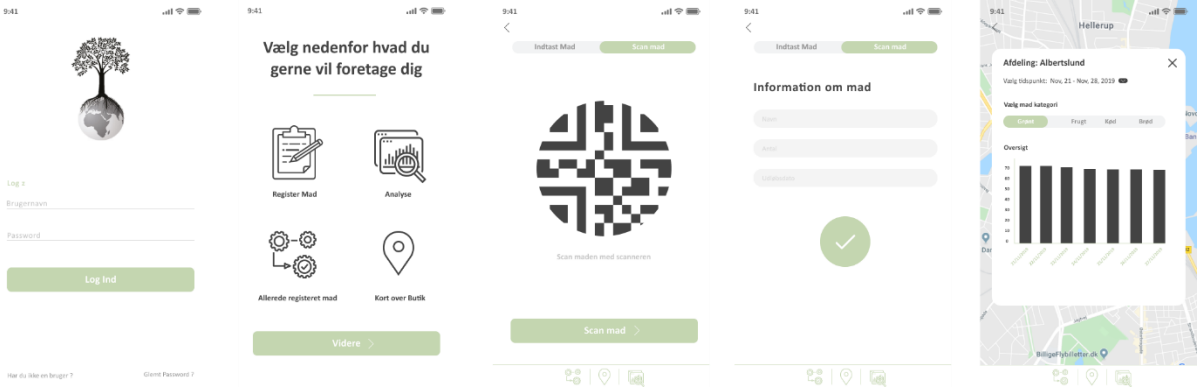
Scenario(s):		Employees want to keep track of the groceries
Relevant quality attributes:		2. I want to have a fast overview of the inventory and specific information back in time.
Scenario parts	Source:	Managers
	Stimulus:	Desire of reviewing their inventory
	Artifact:	System
	Environment:	Search specific groceries to keep track of the inventory
	Response:	Inventory search view where users can view the registered food in process.
	Response measure:	The search should take less than 30 seconds

Scenario(s):		Board employees wants the opportunity to easily and quickly access this data every week to understand which further direction must be taking to further develop SSL
Relevant quality attributes:		3. I want to have a quick access the stored data to perform some analytic tasks.
Scenario parts	Source:	Board Members
	Stimulus:	Desire to get the stored data.

	Artifact:	System
	Environment:	Access to the data from the past month.
	Response:	A downloadable excel file of the requested data together with some simple chart visualizations.
	Response measure:	An Excel file with the data from the requested time rendered in less than 1 minute. Simple chart visualization of the requested data.

Appendix 6 – Mock-ups





Appendix 7 - Sitemap