
Zero Hunger

Redistribution of Food Waste to Combat Global Hunger

Project Report
ITC2b230

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Abstract:

This project attempts to create an online platform for food donations, such that food donors, and food receivers are able to establish communication and arrange food donations. The target food donors are mainly wholesalers, supermarkets, or directly from the manufacturers, which donates food waste to charitable organizations that redistribute the donated foods to people in need. By using food waste, it is possible to not only reduce the number of starving people, but it would also be a sustainable solution, that would be beneficial to the environment in terms of greenhouse gas emission. Furthermore, a reduction in food waste might also be favorable to the economy of each country. The proposed solution works like a marketplace on a website, where both donors and receivers are granted access. The system has been tested on a homogeneous user group that found the system's usability to be good, while the usefulness of the system is inconclusive.

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Preface

This project came about as a project suggestion in august 2018 by Jens Myrup Pedersen, where two students from University of Brasilia, Brazil had an idea during the 2018 Global SDGs Student Challenge. Their idea was to create an IT based system that would make it easier to donate and distribute food to charities, as it could help countless of people in Brazil. This was chosen by a group of students at AAU, and they managed to develop a prototype. The prototype was tested at several charities in Brasilia, including Mesa Brazil, which is the biggest food bank in Brazil. None of this would be possible without the cooperation between the project group, a group of Techno anthropology students, and the Brazilians, with Jens Myrup Pedersen and Giajenthiran Velmurugan (Kalle) as our international supervisors, providing all the help we needed, setting up the conference in Brasilia in January 2019, and facilitating the communication with the brazilian team. We also want to thank Rasmus Løvenstein Olsen and Lykke Brogaard Bertel for supervising the project group in this project. Citations will either be in the end of a sentence or a paragraph, which is determined if it is before or after the period, e.g. [5]. would be a citation to a sentence.



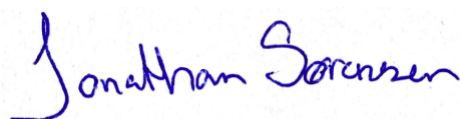
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Nomenclature

<i>Abbreviation</i>	<i>Name</i>
FAO	Food and Agriculture Organization of the United Nations
UN	United Nations
SDG	Sustainable Development Goals
USD	United States Dollar
WFP	World Food Programme
NGO	Non-governmental Organization
NPO	Non-profit Organization
AAU	Aalborg University
EU	European Union
ICT	Information and Communications Technology
GDPR	General Data Protection Regulation
UI	User Interface
API	Application Programming Interface
SQL	Structured Query Language
RDBMS	Relational Database Management systems
JSON	JavaScript Object Notation
HTTP	HyperText Transfer Protocol
HTTPS	HyperText Transfer Protocol Secure
DTL	Django Template Language
SUS	System Usability Scale

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1 Introduction

Hunger is a severe global problem and rather contradictory topic relative to the considerable amount of food waste [1]. In 2017, according to Food and Agriculture Organization of the United Nations (FAO), 820.8 million (10.9%) people was undernourished [2, p. 4]. Despite a reduction from 14.5% in 2005 to 10.9% in 2017, it is still vital to ensure further reductions thus creating an elevated quality of life on a global scale [2, p. xiv]. A part of lowering the percentage will require that new ideas are examined based on both existing and new technologies.

1.1 Hunger on a Global Scale

According to the National Research Council (2006), hunger is defined as a short-term, physical discomfort due to chronic food shortage, or in more serious cases, a life-threatening lack of food. When talking about world hunger, some related terms could be food insecurity and malnutrition. Food insecurity is when the access to food is limited or unreliable, with causes such as natural disasters, climate change, or war. [3]

Malnutrition refers to an inadequate intake of the necessary nutrients, which could mean both overnutrition and undernutrition. Undernutrition is the most common topic when talking about global hunger. The most important type of undernutrition is protein-energy malnutrition, which refers to a lack of protein and calories. The problem with protein-energy malnutrition, is that protein is needed for key body functions, as well as the growth and maintenance of the muscles. [3]

The consequences of malnutrition can be wasting or stunting. Wasting is when a person is having a very low weight compared to their height. Stunting is the term for reduced growth rate and human development compared to the standard height for age. It is a very slow process and it develops over a long period of time without the proper nutrition. [3]

The total number of undernourished people worldwide is estimated to have reached 820.8 million people in 2017. As seen in figure 1.1 on the following page this number has mostly been decreasing between 2005 and 2014, but since 2015 the number has started to increase, with around 20 million more people suffering from undernourishment each year. [2]

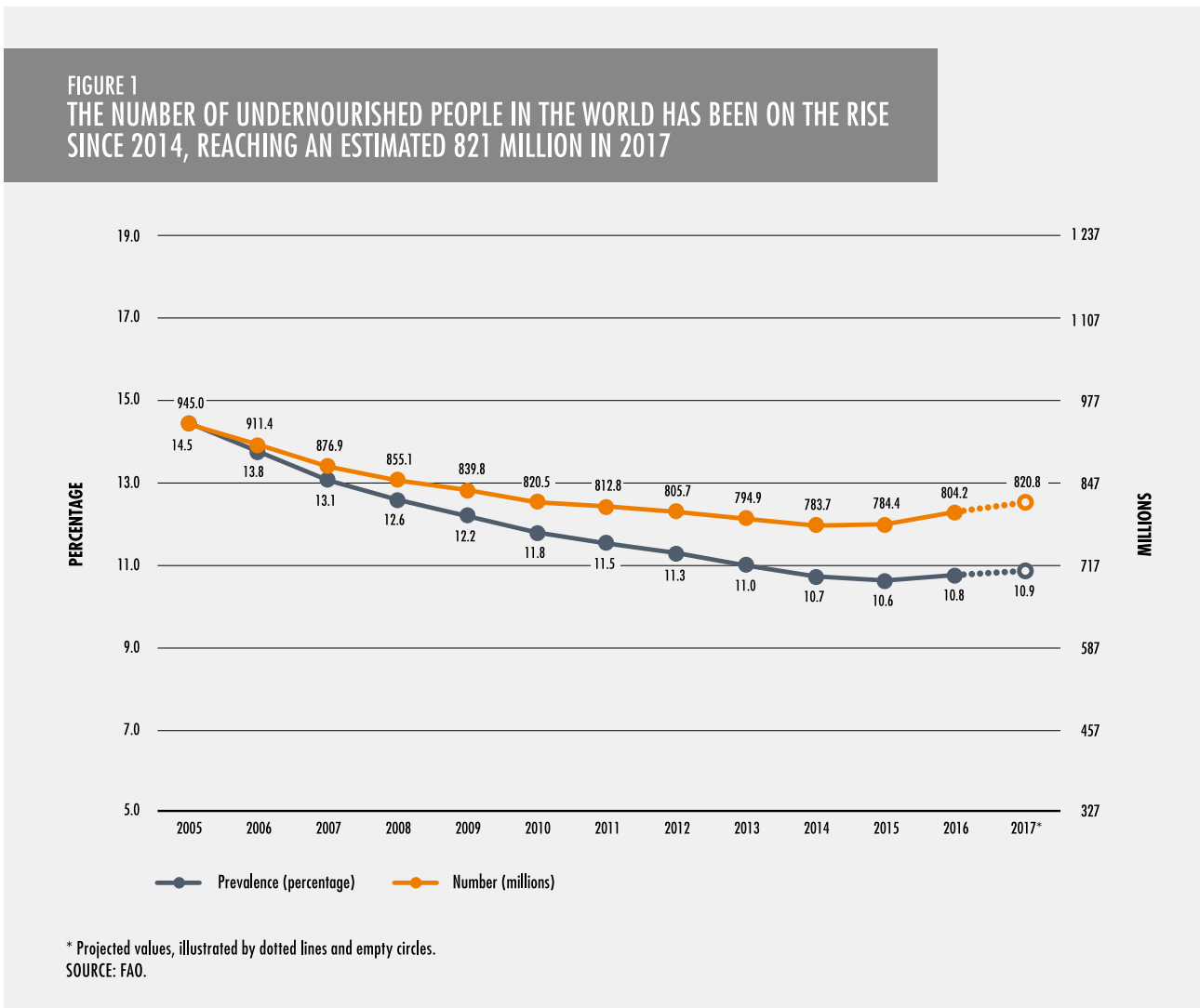


Figure 1.1: The estimated worldwide number of undernourished people. [2]

98% of the people in hunger live in a low and middle income country, which means that there is a high risk that people may live with a very low amount of money per day. The places with the worst cases of hunger are Asia (515.1 million), Sub-Saharan Africa (236.5 million), and Latin America (32.3 million). 60% of the undernourished people are women, which results in one sixth of all infants being born with a low birth weight in all of the low and middle income countries. Furthermore almost half of all deaths in children under the age of 5 are linked with undernutrition. [4]

Figure 1.2 on the next page shows how undernourishment is spread across the world. It shows that the largest percentage of undernourished people are in Africa, but the largest amount of undernourished people resides in Asia. The country with the highest amount of undernourished people is India, where 195.9 million (14.9%) of the population is affected. Comparing this number to a first world country like Denmark where, according to figure figure 1.2 on the following page, the percentage of undernourished is below 1%. [3]

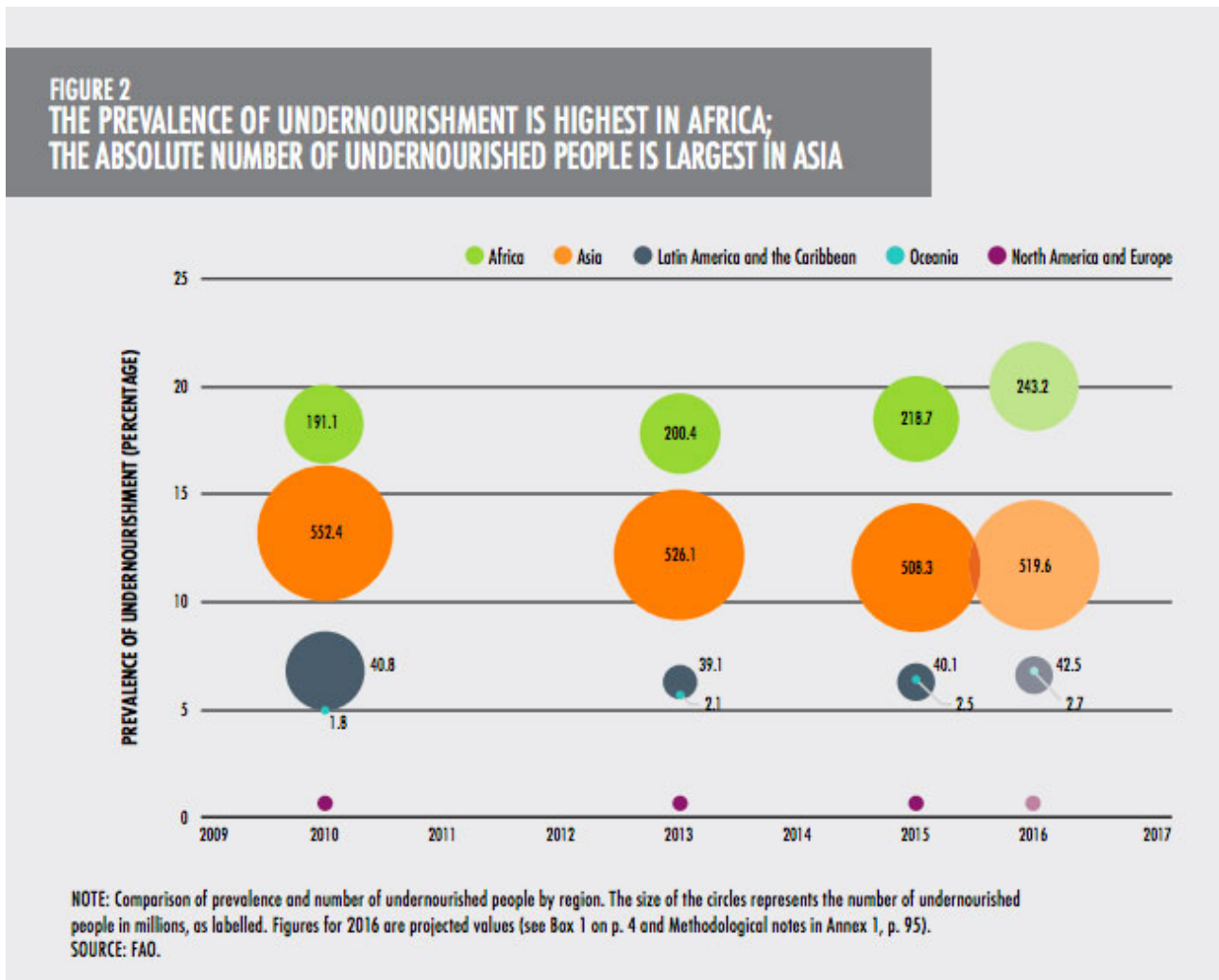


Figure 1.2: Visual representation of an overall projection of undernourished people worldwide from 2016. [3]

First World Hunger: Food Security and Welfare Politics from 1997 discusses the term of hunger in the context of first world countries, since the undernourishment and malnutrition numbers is vastly different compared to developing countries.

Therefore, the term food insecurity is used to describe an uncertainty of getting food on an every-day basis.

FAO defines Food security as:

"A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Based on this definition, four food security dimensions can be identified: food availability, economic and physical access to food, food utilization and stability over time" [3]

1.1.1 Food (in)security

A revisit of the earlier mentioned publication done in 2017, discusses food as a human right instead of a charitable act [3]. Although first world countries do not suffer from hunger, there are still cases of food insecurity. The difference between hunger and food insecurity lies in the cause and consequences. While hunger refers to a physical sensation of discomfort, food insecurity refers to a lack of available food or availability of food. A prolonged case of severe food insecurity could however lead to hunger.

Food insecurity has been shown to be closely related to the poverty rate of a specific country, however, multiple factors can affect the food insecurity rate, such as specific household expenses and illness in the family. Furthermore, there are different degrees of food insecurity, depending on the severity and consequences. [2]



Figure 1.3: The different levels of food security. [5]

In figure 1.3, high food security relates to households that does not have issues with the access to food. The marginal food security are households that mostly have good access to food. Low food security are when households have to adapt to certain kind of food diet because of the lack

of access to food. The very low food security arise when a household's food intake are reduced because of the lack of either money or food. [5]

Over the last years, severe worldwide food insecurity has increased, especially due to the African regions, where severe food insecurity has greatly increased, due to poverty, but also wars and political instability. [6]

The amount of hunger and food insecurity that is around the world makes it relevant to look at what initiatives that is established in order to fight hunger and food insecurity.

1.2 United Nations Sustainable Development Goals

The United Nations (UN) is an international organization founded in 1945. It is currently made up of 193 member states, with the main objective of taking actions against the issues confronting humanity in the 21st century, such as peace, security, climate change, sustainable development, human rights, terrorism, humanitarian and health emergencies, gender equality, governance, food production, and more. [7]

To take action against these issues, numerous funds, programmes, and specialized agencies have been founded, such as the UN Environment Programme, which is the voice for the environment and promotes the wise use and sustainable development of the global environment and the UN Children's Fund, that works in 190 of the countries by focusing on the future of children. One of the UN's specialized agencies are FAO, which leads the international efforts to fight hunger. [8]

To make awareness of the issues, UN has made the Sustainable Development Goals (SDG), which is a series of 17 goals, that UN wants to achieve by 2030, with each of the goals being divided into smaller targets. The intention of the SDGs is to make an agenda that, if followed, improves the living conditions of every human on earth meanwhile leaving a sustainable planet for future generations. [9]



Figure 1.4: A visual presentation of all the SDGs. [10]

This project will mainly focus on the second SDG; Zero Hunger. The goal attempts to create an universal goal, with an universal agenda that involves how we grow, share, and consume food. As not all countries and citizens of these countries have the same accessibility to food, a change in the agricultural system is needed to nourish 820 million people, about 1/9th of the worlds population that lives in hunger, with an expected additional 2 billion undernourished people by 2050. Because of the rapid growth in population in developing countries the agricultural capacity, productivity, and sustainability systems have to be improved, in order to evolve and sustain a perishable resource. [11]

The project is also involved with the twelfth SDG; Responsible consumption and production, which works on decreasing the consumption and waste of resources and materials on global scale. An important aspect is food waste, which is meant to be reduced during production, retail and at consumer levels.

At consumer levels, the substantial environment are impacted by the households in the food production phase, as agriculture and food processing, through the dietary choices and habits. The varying consumer choices and habits results in environmental consequences through food-related energy consumption and waste generation. It is estimated to be 1/3th of all food produced that ends up rotting in the bins of consumers and retailers, or spoiled during poor transportation or harvesting, each year. That is equivalent to be around 1.3 billion tons food worth around 1 trillion United States Dollars (USD). [12]

The natural resource base for supplying food are also impacted by the affects from increasing

land degradation, with declining soil fertility, unsustainable water usage, overfishing and through marine environmental degradation. The global energy consumption is greatly influenced by the food sector with around 30% of the world's total energy consumption used by the food sector while the sector also accounts for around 22% of the total Greenhouse Gas emissions. [12]

1.3 Actions Against Hunger

In order to further analyze the current situation of food donations, this section will be about the current actions against hunger, both on a political but also physical level.

Various organizations are founded to combat hunger on a global scale, some of which are mentioned in this section. The World Food Programme (WFP), a branch of UN, is the largest humanitarian organization helping almost 92 million people in 83 countries around the world each year. WFP is working towards reaching five objectives in 2021 which are based on the second and seventeenth UN SDGs - see figure 1.5, as well as providing emergency food assistance in emergencies. [13]

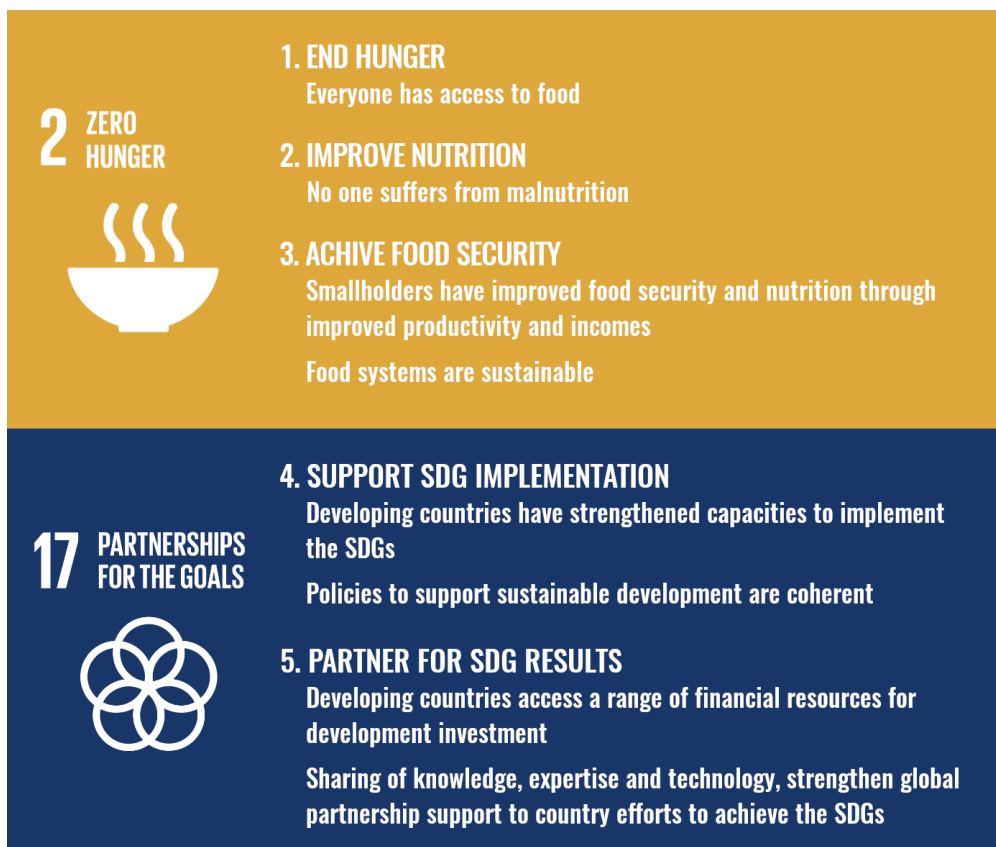


Figure 1.5: WFP's Objectives 2017-2021 and their based UN's SDG, with measurable results. [14]

After the SDGs were made in 2015, it was logical to incorporate them with the strategic objectives of WFP, which were renewed in 2017. As figure 1.5 shows, the second SDG; Zero

Hunger, and seventeenth SDG; Partnerships for the goals, were included. Because the strategic objectives are based on the SDGs, the SDG indicators can be used to measure progress when evaluating later on [15]. However not all strategic objectives and results apply in all countries, but the activities by WFP reflect the context and needs in a specific country or region. That means that the influence from the WFP are determined by the particular time and space, and the presence and capabilities of other actors working in the place. For example, WFP work together with the African Union and its Regional Economic Communities to identify the specific challenges in realizing zero hunger in Africa, and implementing programmes to strengthen the capacities of communities and countries, save lives and livelihoods and finally end hunger. [14]

Beside working towards the strategic objectives, the WFP provides emergency aid to people whatever they are victims of war, conflicts, or natural disasters. This is done by cooperating with local aid organizations, who can provide WFP with local knowledge about the area of purpose. This is possible with the partnership with more than 1000 national and international Non-governmental organizations (NGO). When the need for emergency aid has passed, WFP provides their services, together with their local NGO partners, to rebuild peoples life and community with strategic use of food. [16]

Another organization who works towards ending hunger is The Global Foodbanking Network. In 2018 their global network of 811 food banks served 7.78 million people by distributing 472 tons of food [17]. A food bank works by receiving donations in form of food from various sources, such as food producers or retailers. For example, producers sometimes make incorrect productions or overproduction of food, which usually would end up as waste [18]. These donations are then stored in a warehouse for later distribution among other hunger-relief charities across the country [19].

1.4 Vision of Project

In the fall of 2018, a group of students at Aalborg University developed an IT-system, which aimed to reduce world hunger by taking advantage of the inefficiencies in food production and distribution. The system uses food waste to combat hunger, by establishing, and simplifying communication between organizations with leftover food, and charitable organizations that provide food to people that are unable to reach their appropriate nutritional needs on a daily basis.

The project Teule *et al.* [20] found that the process is tedious and very time consuming, wasting a lot of the charities' workers time, most of which are volunteers. The charities also had staff issues, as they did not have enough volunteers, so the time they allocate to find and contact donors is a big issue. The system was based on interviews with stakeholders of the system, which created an overview of how they currently operate. The above mentioned group managed to conceptualize this idea and hereby creating a proof of concept. [20]

This project will build a new system with a new analysis of the problem whilst building on

the gathered information from the previously mentioned project. The project Teule *et al.* [20] was built with the aim of being applicable in Brazil, it was however only done with Danish stakeholders.

In order to reassure that the system would be applicable in Brazil, a trip to Brasilia was made in extension of the previous project. It was found that the need for such a system was more needed than first assumed. Whilst in Brazil multiple visits to potential stakeholders were organized and numerous interviews were conducted with the help of local Brazilian students which can be seen in appendix A on page 83. This confirmed that the issues the charities has actually is real issues.

When donating food, the communication between donors and charities is through telephone, where the charities usually search the internet for potential donors, and contact them by phone. They then discuss whether the donors have any food available for donation at the moment. If they both agree on a donation, they will set up a date and location where the donation can be picked up. The charities will then distribute the food to those who need it. This process can be seen in figure 1.6.

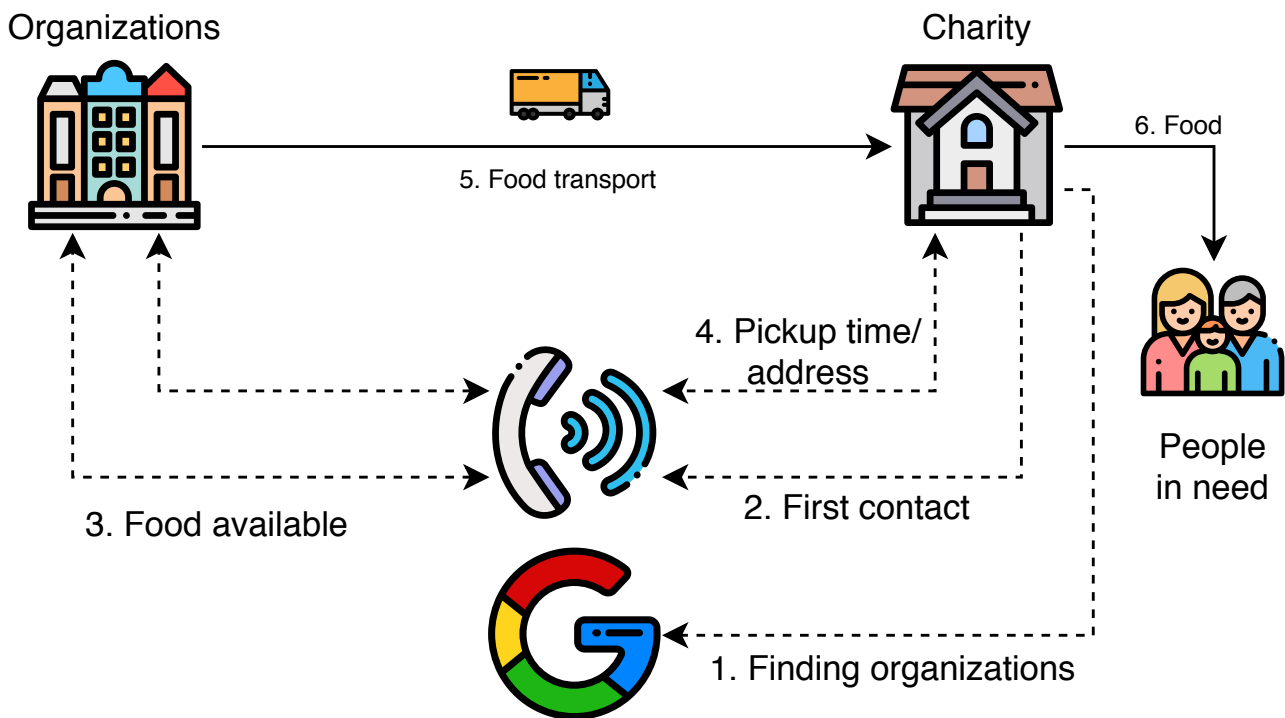


Figure 1.6: Illustration of current process. [20]

A proposed system could work like a marketplace, where donors can list surplus food for charities to pick up and redistribute to people in need. UN’s SDGs were presented in section 1.2 on page 5 with focus on goal number two, addressing the challenges of reaching zero hunger in the world. This project will use this as a point of reference and focus on the second goal of the SDGs.

In contrary to the former project, this project is meant to result in a final, usable product and not only a proof of concept. As a result, the specifications and requirements will have to be changed accordingly to the stakeholders wishes. In order to ease the process of communication with the stakeholders, the focus will be shifted towards local stakeholders. This will be done while still keeping the rest of the world in mind, by researching the issues and situations in different areas like newly industrialized countries or developed countries.

This project will focus on creating a platform that enables a national infrastructure of redistribution of processed and unprocessed foods. The system should be globally available and have a general ease of use. In order for this system to work in multiple countries, the features should be as universal as possible.

The platform will act as a marketplace with the two possibilities of either donating or receiving. Organizations, companies, or others, will be able to set up a listing of food that is available for pick-up, hereafter other organizations and charities will be able to see this listing and then reserve the donation, which can be seen in figure 1.7.

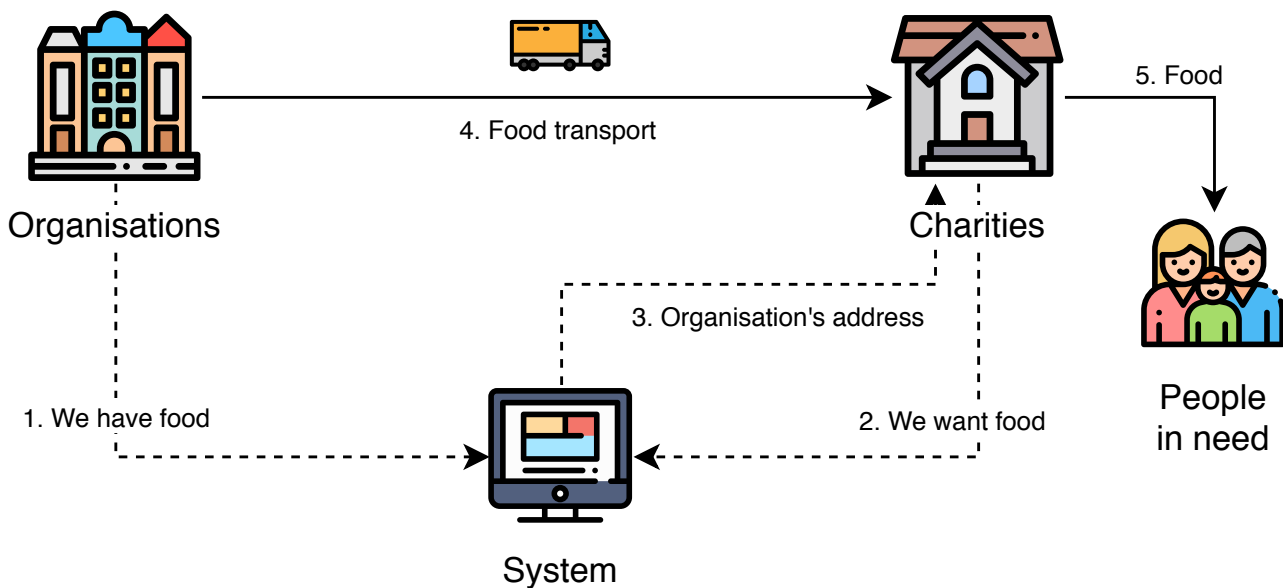


Figure 1.7: Illustration of the proposed solution. [20]

The infrastructure will serve as an initiative of fighting hunger, food insecurity, and food waste. Ultimately the system should be ported to as many platforms as possible in order to heighten the experience of the user by giving the user the possibility of choosing which device to use for themselves (see section 2.4 on page 28). Moreover, porting the system to multiple platforms means more possible users and thereby a more portable solution. Moreover, the optimum solution would be able help local charities and organizations such as the ones mentioned in section 1.3 on page 7.

This project will focus on Denmark and Brazil as two case studies, since they reflect two very different contexts. The Danish context will reflect a country that does not suffer from hunger,

but has food insecurity among the poorest citizens. It also represents a developed country, meaning that if it can be used in Denmark, then it is hypothesized that the system is also deployable in other developed countries.

The Brazilian context will reflect a country that does suffer from hunger, but also represents a newly industrialized country that are striving to become a developed country. A certain infrastructure is needed in order for the product to be useful, meaning that developing countries without a lot of food waste, but instead a need for food, wouldn't be able to use the product. Moreover, a general infrastructure and redistribution of food supply is needed, which is postulated to be less sufficient in developing countries. The scope of this project will only be newly industrialized countries and developed countries.

By using two distinct and diverse use cases and finding the similarities of such, it might help the system becoming more universal and moreover it could potentially provide the necessary information to create a system that is applicable world wide.

1.5 Initial Problem Statement

How prevalent is food waste worldwide, is it a feasible source to combat hunger? How can an IT system be built to relieve the complications of organizations in both developed and developing countries?

2 Problem Analysis

This chapter deals with the research of food waste and loss world wide at manufacture, retail and consumer levels. In addition, it deals with the differences in hunger, food security among continents, with a scope on developed countries and newly industrialized countries. Furthermore, it covers the regulations of food donation and a stakeholder analysis for the project.

2.1 Food Waste

This section deals with surplus food, food waste and food loss on a global scale. In addition, it focuses on the various steps in the food supply chain where the surplus food and waste occur, and identifies the key barriers to food donations, the economical impacts and some current interventions around the world and in Denmark.

Food waste is defined by FAO as:

"Food loss is defined as "the decrease in quantity or quality of food". Food waste is part of food loss and refers to discarding or alternative (non-food) use of food that is safe and nutritious for human consumption along the entire food supply chain, from primary production to end household consumer level. Food waste is recognized as a distinct part of food loss because the drivers that generate it and the solutions to it are different from those of food losses. [2]"

It is estimated that a third of all produced food in the world is either lost or wasted. Each citizen in North America and Europe generates approximately 95-115 kg of food waste each year, whereas in sub-Saharan Africa and South/Southeast Asia it is estimated to be 6-11 kg each year [2].

In a report from 2015 done by the Danish Agriculture and Food council, it was found that on average, Danish people throw out 47kg of consumable food per person. This accumulates to approximately 11.6 billion Danish kroner in all Danish households. On a national level it is estimated that the yearly food waste in Denmark is 716.942 tonnes which is from production level to consumer level. Furthermore, retailing accounts for 151.000 tonnes of food waste, which are lead by warehouses and discount stores. [21]

In the United States it was estimated that some of the highest food loss categories in retail included: Dairy, grain products and vegetables, which totaled to approximately 10.6 billion kilograms of food in 2010. These three categories amounts to 44.7 billion calories. [22]

According to FAO, food waste and food loss in developing countries were mostly happening on the production level, which means optimization of this process is harder than in first world countries. A figure of the amount of food waste and loss in multiple areas can be seen in figure 2.1 on the following page.

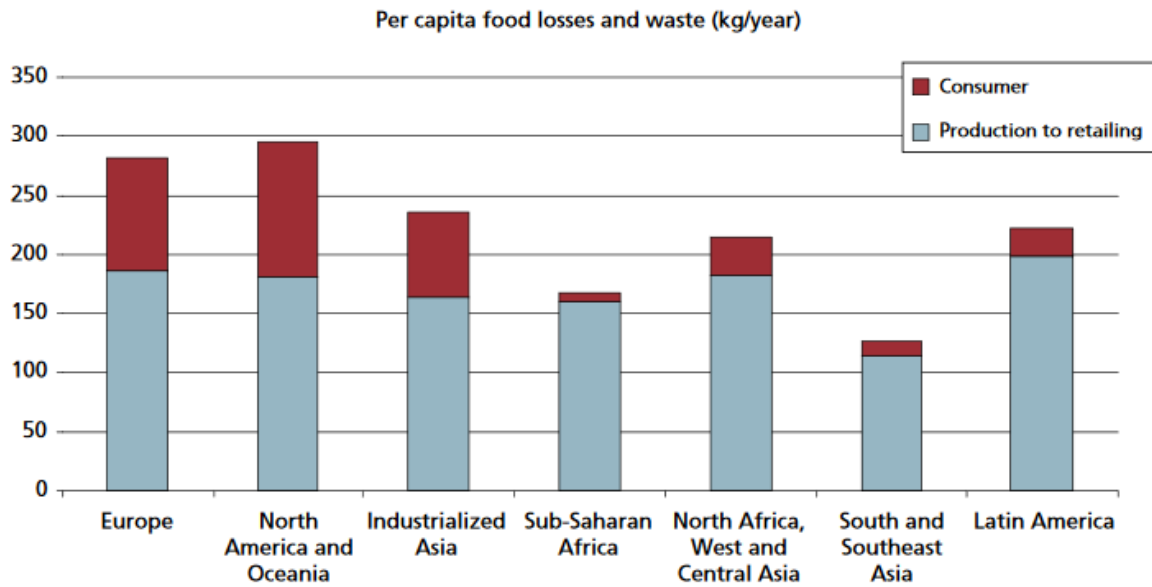


Figure 2.1: Food loss and food waste in kilo grams per year per capita in multiple countries. [22]

In figure 2.1 it can be seen that the amount of food waste and loss between production and retail level is almost equal across all continents and areas in the world. However, food waste and loss on consumer level are much higher in first world countries than in developing countries.

A chart of the distribution of food waste alone, not food waste and loss combined (as in figure 2.1), in different areas can be seen in figure 2.2.

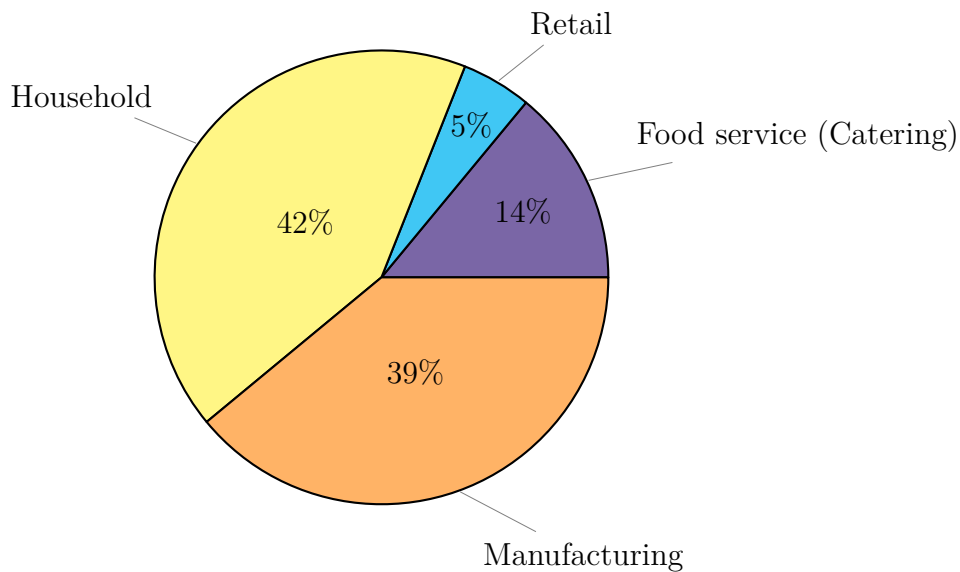


Figure 2.2: Chart representing food waste from different levels of the food supply chain in Europe from 2006. [23]

Figure 2.2 on page 13, shows that the highest cause of food waste is happening on consumer level which is out of scope for this project as previously mentioned. Moreover, 39% of food waste is happening on manufacturing level, however according to the European commission the estimate is predicted to be wrong because of different definitions of food waste in the manufacturing sector. Excluding households the accumulative food waste of the remaining sectors is approximately 103kg¹ per capita every year in Europe. [23]

This project will not focus on consumer level food waste and loss but instead on the steps from production level to retail level.

2.1.1 Economical and environmental impact

Food waste amounts to approximately 1 trillion USD each year worldwide [24]. According to Buzby *et al.* [22] it is estimated that the total food loss in the United States on retail level alone accumulates to 46.7B USD. This is 8% of all food supply in the retail section that is lost. [22] In South Africa it is estimated that every year food waste alone amounts to 2.1% (≈ 7.7 B USD²) of their entire Gross Domestic Product, which is from all steps of the food supply chain, whereas in USA it is estimated to be around 0.6%-1.3% of their Gross Domestic Product. [25]

In addition to the direct costs of food waste and loss, there are also indirect economical impact from food waste and loss. This includes the environmental damages which is suggested to be around 700B USD and social costs to be around 900B USD. [24]

According to Porter *et al.* [26] the food loss and waste related greenhouse gas emitted between 1961-2011 in Europe was 17% in the production phase with a 5% increase in food loss and waste. However, in Latin America and Industrialized Asia (Japan, China, South Korea) the increase of food loss and waste related greenhouse gas had risen with 243% and 50% accordingly, see table 2.1. [26]

Table 2.1: Greenhouse gas emission related to food loss and waste - Percentage increase from 1961 to 2011 (Based on data from Porter *et al.* [26]).

Region	Per capita food loss and waste (mass basis)	Associated production-phase greenhouse gas emissions
Europe	5%	17%
Latin America	53%	50%
Industrialized Asia	123%	241%
South and South-East Asia	62%	58%

As seen in table 2.1 both the greenhouse gas emission and food loss and waste per capita in Europe had a significantly lower increase compared to the other regions.

¹This estimate is a sum of the three sectors combined.

²This number is converted from South African currency (Rand)

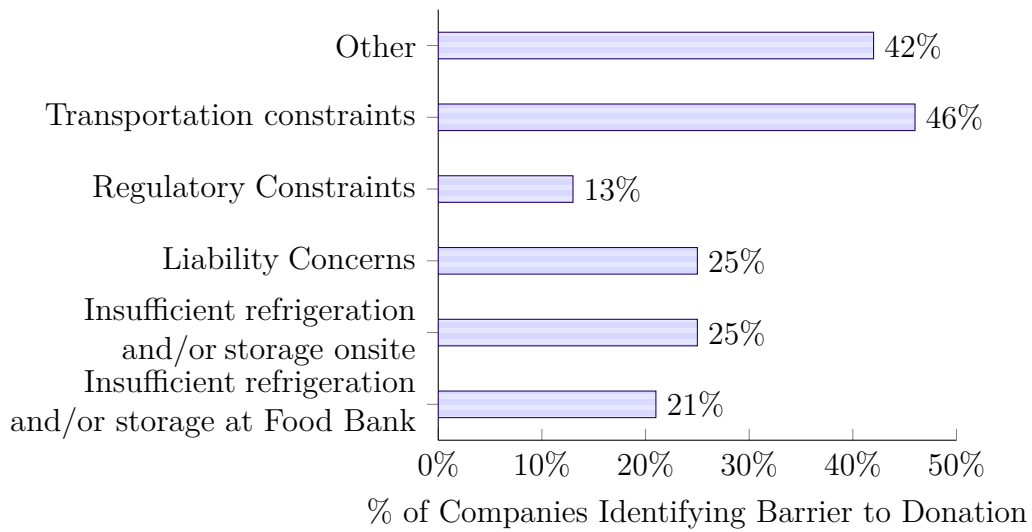


Figure 2.3: The key barriers to donation for the retail sector. [27]

2.1.2 Barriers to donation

A joint project by the Food Waste Reduction Alliance, which is a collaborative effort between the Food Marketing Institute, the Grocery Manufacturers and the National Restaurant Association, made a survey to analyse the food waste among food manufacturers, retailers and restaurants. In the retail sector, the survey had respondents from 24 food retailers / wholesalers, which represents over 10.700 retail locations, 100 manufacturing locations and over 130 food warehouses. Broken down by the company size as shown in table 2.2.

Table 2.2: Retail and Wholesale respondents broken down by the company size. [27]

Size	Definition	# of respondents
Small	<1 billion USD	12 respondents
Medium	>1 billion USD and <10 billion USD	6 respondents
Large	>10 billion USD	6 respondents

The key barriers for the retailers and wholesalers to donate unsellable food have been identified as shown in figure 2.3.

Figure 2.3 shows what percentage of the retail and wholesale companies marked the specific obstacles as a big challenge for the company. According to the survey, transport constraints were the biggest challenge of the obstacles, though the large and medium-sized companies were more likely to mark this as the biggest challenge, while the small-sized were more likely to mark ‘Insufficient refrigeration and/or storage onsite’.

The difference in barriers may be caused by the resources available to the companies, as well as

the amount of food available for donation. "Other" were the second biggest obstacle and includes both external and internal organizational challenges. The external challenges were described as a lack of food donation agencies in the area and a lack of volunteers able to pick up the food for donation. *“Internally, retailers / wholesalers reported a lack of resources, oversight, and established processes limit their ability to properly facilitate donation efforts.”* [27]

2.1.3 Interventions

In order to reduce food waste, various laws and initiatives have been declared all around the world. Since there are no international laws concerning food waste, each country has its own way of dealing with the problem.

There have been made many charities who only work with food donations. An example of this is the danish Stop Wasting Food movement³, which is Denmark’s largest non-profit movement against food waste. This initiative has caused most danish retail stores to adopt the notion of reducing food waste. The Stop Wasting Food movement has stopped more than 300 tons of food from being wasted since 2011. [28]

In Berlin a project named Culinary Misfits seek to reduce the waste of unaesthetic products, which was deemed one of the root causes to food waste in retail. [29]

In the previous mentioned report from the Danish Agriculture and Food Council it was highly suggested to donate surplus of food to social organizations.

Italy has worked towards making it easier for companies to donate food by relaxing the existing law around food donations, such that it is now legal to donate food past the best-before date. Denmark takes this one step further and even makes it legal to sell this food, as long as it is clearly labeled and does not show any signs of health risks. [30]

There even exists a small danish supermarket chain, named WeFood, which only sells food from donations (often from larger supermarkets) at a low price. The profits then go to other charity projects, also initiated by WeFood. In 2018 did WeFood sell more than 173.3 tons surplus food. [31]

France has taken more drastic actions, making it illegal for large supermarkets to dispose of food past the “best-before” date. Instead they are required to donate it to charities and food banks, who then can redistribute it to people in need. The law only affects 11% of the total food waste in France. [32]

In figure 2.4 on the following page a hierarchy of food recovery preferences from United States Environmental Protection Agency. The highest located item should be seen as the method with the lowest environmental, economical, and societal impact as possible. [33]

³Stop Spild Af Mad

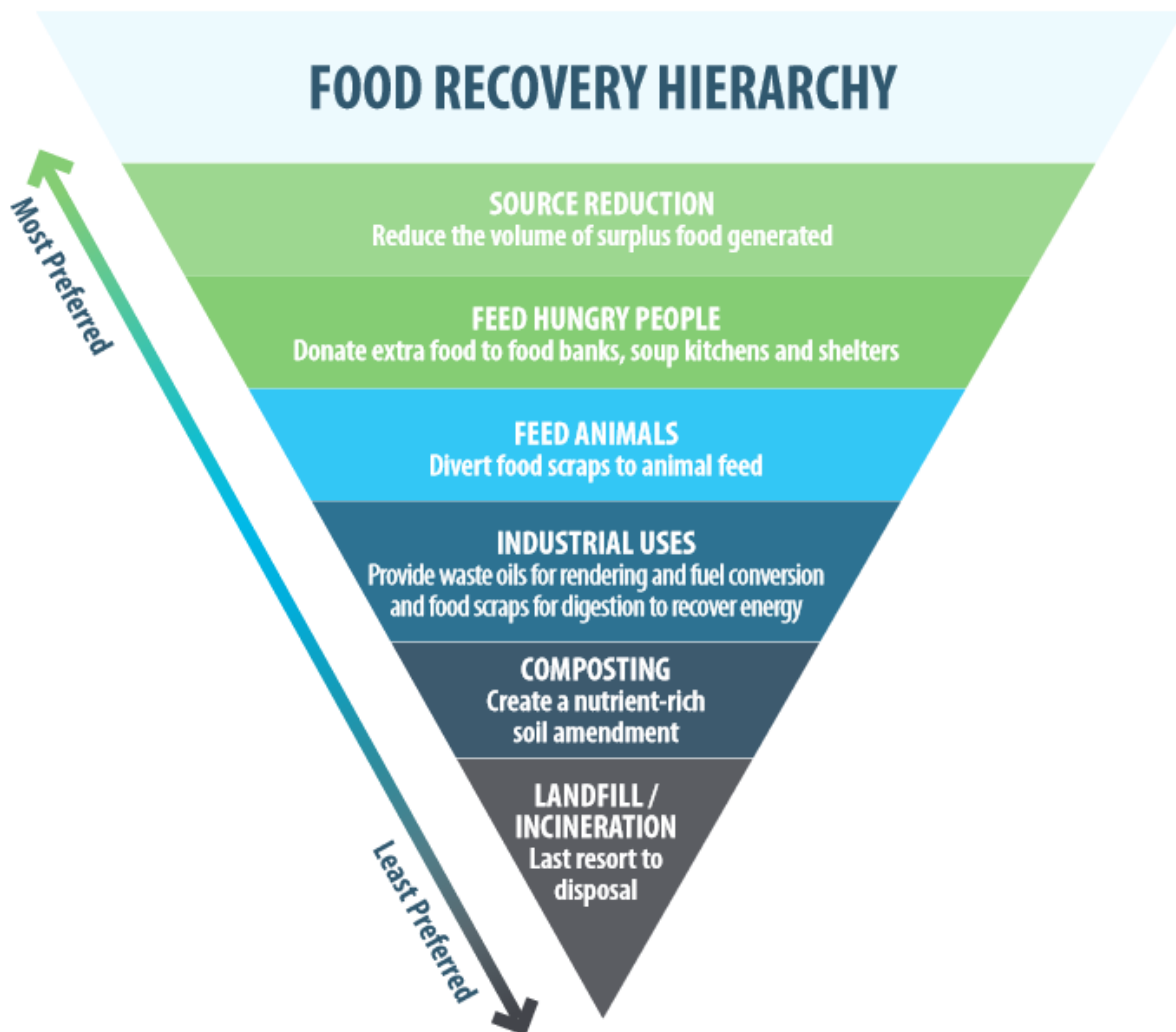


Figure 2.4: Hierarchy of preferred approaches to reduce food waste and loss.
(Source: US EPA, data adapted by UN Environment programme) [24]

In the above-mentioned figure, it can be seen that the highest preferred approach is to reduce the initial production of the food. Hereafter, the second highest preferred approach is to use the food surplus to feed hungry people, which is within the scope of this project. [24]

2.1.4 Food Distributed by Danish Charities

Food waste is not only an important topic to UN through the SDGs, but also for Denmark as a nation. There are several organizations in Denmark that work to re-distribute surplus food, that earlier would have been discarded. Mostly focusing on socially vulnerable people, are organizations such as The Danish Food Bank⁴, Northern Jutland Food Surplus⁵ and Stop

⁴Fødevarebanken

⁵Nordjysk Fødevareoverskud

Waste Locally movement⁶.

The Danish Food Bank is a nonprofit organization(NPO), who fights to decrease food waste and food poverty in Denmark. They distributed 914 tons of food in 2017, nationwide in Denmark. This provided a total of 2.285.000 meals. [34]

Northern Jutland Food Surplus is a NPO who fights for sustainability and food poverty in Denmark. They distributed more than 180 tons of food locally in Aalborg in 2018, through their program, that specifically focuses on reducing food waste while helping people in need. The total food distributed by Northern Jutland Food Surplus is shown in figure 2.5.

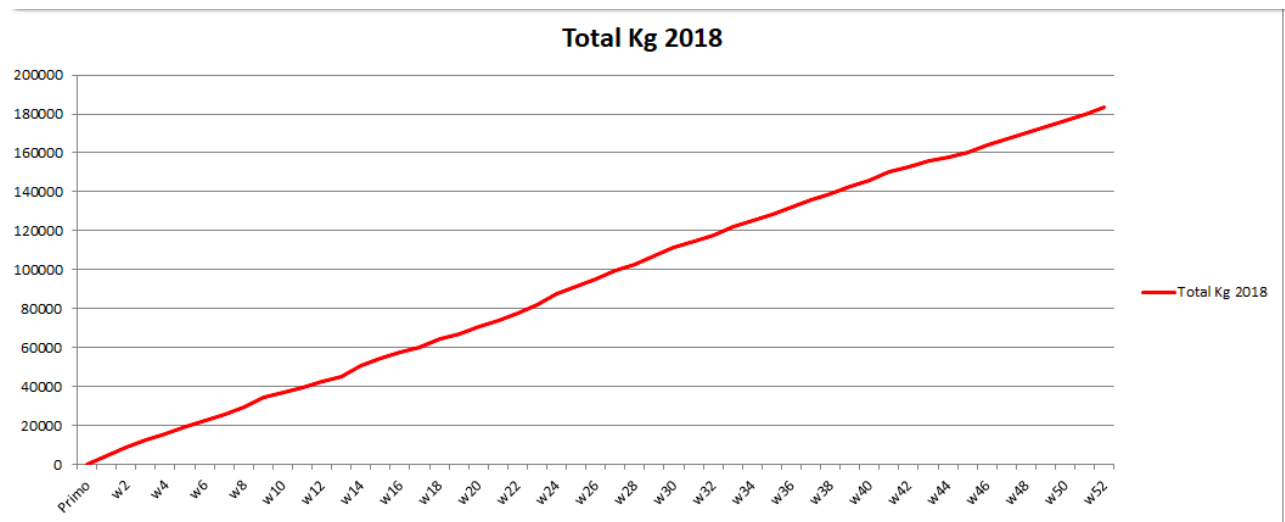


Figure 2.5: Statistics of food distributed by Northern Jutland Food Surplus in 2018.

Stop Wasting Food movement connects private persons who have surplus food with each other, through local Facebook groups. In addition to establishing contact between private persons, they have 7 "food oases", where socially vulnerable and homeless people, institutions and others can come and get food. This is the foundation that makes the Stop Wasting Food movement able to distribute between 5 and 7 tons of food per day, which else would have been discarded. [35]

In this section food waste was analyzed to see how big of a problem it is worldwide, and what barriers that occur when organizations want to donate surplus food to charity. The economical and environmental impact of food waste and food loss was researched, and what interventions exists to fight food waste globally. The interventions in Denmark is looked further upon, in order to see what Denmark is doing against food waste. Looking into what is already get done to fight food waste, some potential national and local stakeholders was found.

The results will be used to prove the existence of food waste, as well as used to prevent problems in the system, that could make donating food difficult for the users.

⁶Stop Spild Lokalt

2.2 Stakeholder analysis

In order to increase the chances of successfully developing a product, it is necessary to find people, groups, or organizations who might have an interest or concern regarding the product. The following stakeholder analysis will identify the relevant stakeholders for the product, and how each of them will be handled, in order to develop the best possible product. The stakeholders will be mapped out depending on how much influence they have in the product, as well as their interest and power, which will then be presented in a stakeholder matrix.

2.2.1 Identifying the stakeholders

- **Aalborg University (AAU)**

AAU has been identified as a stakeholder, as the project is a result of a cooperation between AAU and University of Brasilia. Therefore, AAU has both influence and interest in the project being a success, as it can further their international cooperations, as well as new projects for the university to take a part in. Their influence mainly derives from supporting the project with several supervisors, offices, and funds.

- **University of Brasilia**

University of Brasilia has an interest in the product, as they believe that the system can help the hunger situation in Brazil, as well as strengthen their international relationship with AAU.

- **Techno Anthropology Students**

The Techno Anthropologists are working on a separate project alongside this project, to close the gap between the system and its users, by providing their expertise in creating technology that is applicable in real world situations.

- **Production Engineering Students**

In Brasilia, Brazil, 4 Production Engineer students from University of Brasilia participate in the project, as they have an interest in improving the conditions of the poor people in Brazil, as well as furthering University of Brasilia's agenda for international relationships. The idea of the project derives from two of the participating students, which they presented to an AAU representative in August 2018, at the SDG Global Students Challenge.

- **Food Donors**

Food donors are the organizations that provide food to the receiver organizations through food donations. This is typically an organisation that is involved in the food supply chain, such as supermarkets and catering companies. They are also one of the main stakeholders, as they will be the providers of donations in the product, and are needed to continually participate in using the system.

- **Food Receivers**

These are charitable organizations that provide food for free, or at a greatly reduced cost to people that are unable to feed themselves with sufficient food every day. The food that

they give to the people in need is food that they received through donations from various sources. They are one of the main stakeholders, due to their importance in continually participate in using the product.

- **The environment**

Today's way of misusing resources is in no way sustainable for the environment. Since the product aims to improve the distribution of resources that are being wasted, it contributes to a greener way of living, providing a cleaner, and more sustainable environment for future generations. Whether or not the environment is a stakeholder can be debated, but since lowering food waste helps on the environment it is made a stakeholder.

- **United Nations**

UN has an interest in the project, as any initiative to further their SDGs, as it tries to fight hunger, as well as create awareness about world hunger. During the Global Students SDG Summit 2019 in Brasilia, a UN representative was present, showing interest in all the initiatives that were part of the conference.

- **Danish Embassy**

During the Global Students SDG Summit 2019, the Deputy Minister Counsellor at the Royal Danish Embassy was present, and showed interest in the initiative, as it strengthens the international relationship between Denmark and Brazil, as well as improves the living conditions of the socially vulnerable.

- **Governments**

The governments that the system is used in, has to be taken into account while developing and implementing the system, as there are restrictions and regulations that will apply to the system and its users. Most governments are part of a Union that provides a set of laws that all governments has to abide by, but their implementation can vary from country to country.

- **People in Need**

The main goal of the product is to create a platform for food donations, in which receiver organizations collect food for people that are unable to achieve sufficient nutritional needs. These people are affected by the product, as they will be able to receive larger amounts of food on a daily basis from the receiver organizations. The people in need are not directly linked to the system, but indirectly through the receiver organizations, and are therefore their responsibility.

- **Jens Myrup Pedersen**

Jens Myrup Pedersen is a professor who facilitates the interdisciplinary work across studies and borders, in order to teach the students involved to work together with problem solving across academic studies. Additionally, he has an interest in creating real solutions to real problems to make a difference in the world, and to further international cooperation between universities across the world.

2.2.2 Prioritizing and Handling of Stakeholders

In order to get an overview of the stakeholders for the product, they are prioritized in a "Power and Interest" matrix. This is done to figure out where each of the stakeholders lie, compared to others when measuring their interest vs. their power in the product. The handling of the stakeholders will be based on their power/interest in the product, which is shown in figure 2.6. The handling of each each stakeholder will be described below: [36]

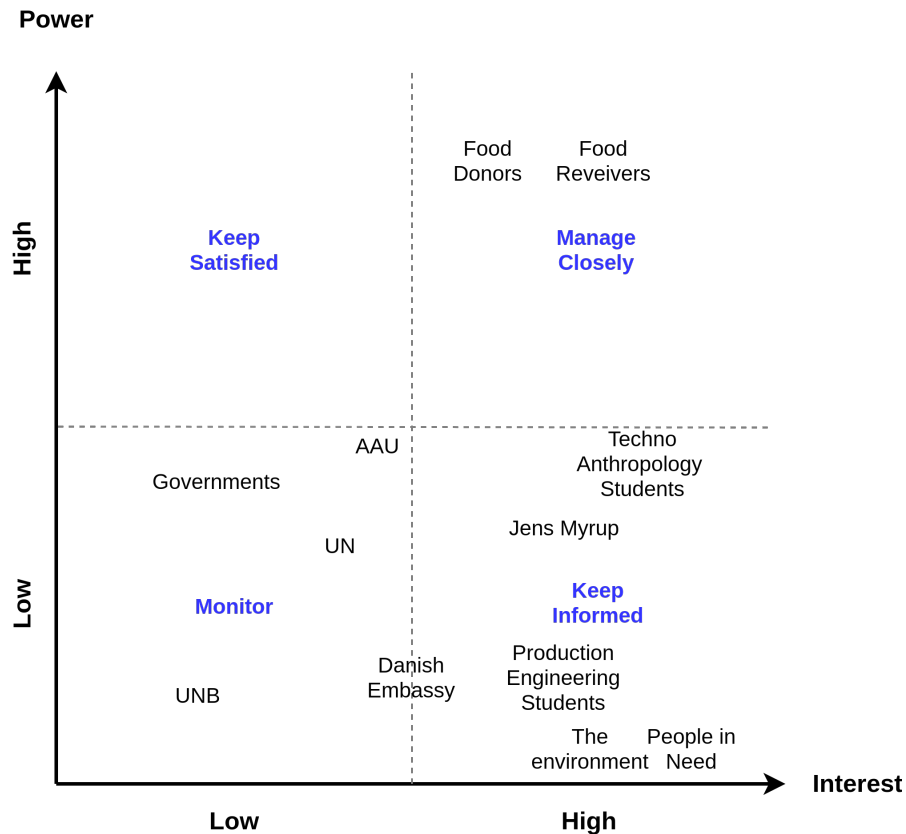


Figure 2.6: Power and Interest matrix of stakeholders.

Monitor

These stakeholders have low power and low interest for the final product. They are not directly involved in any way, but will be lightly taken into account when decisions are made.

- **University of Brasilia**

Since University of Brasilia has the interest of building cross country relationships, it was important to keep all parts informed during the project, which will be done.

- **United Nations**

The project follows the spirit of the United Nations, and keep their guidelines in mind.

- **Aalborg University**

It is important for the project that it follows Aalborg University's interests, which are

to successfully educate their students throughout projects, meanwhile not damaging its publicity in any way. This is taken care of by following the rules and guidelines set beforehand, communicated through supervisors that knows AAUs interests.

- **Danish and Brazilian Government**

Research is done on how the IT-System can benefit a country in the best possible way. There was be no specific handling of governmental stakeholders, but they were kept in mind in order not to displease any governments.

Keep Informed

These stakeholders that are not directly involved in the process of developing the product, but will have to be kept informed.

- **The environment**

The system was developed with the environment in mind. This was done by understanding how the environment can benefit the best from a system that utilizes the resources better than what is being done today.

- **Jens Myrup Pedersen**

Jens Myrup Pedersen will assist in the interdisciplinary communication between the academic study groups, as well as the communication with other stakeholders, as his experience and expertise is essential for the collaborations. He will follow the project from the sideline, and he will be kept informed.

- **People in Need**

People in need are the people who use charity institutions, that gives out free food and meals. Their power in the project is low, but they have a high interest in a working system, as it potentially will increase the availability of food. Because they are not users of the system, but simply has an interest in its success, no action was taken in including them.

- **Production Engineering Students**

The production engineering students was kept informed during meetings, and their inputs were discussed.

Keep Satisfied

These are stakeholders that have a high power, but low interest for the product. They have the capacity to modify the product, without having direct interest, or even knowing of the initiative, but may have restrictions to what is allowed, or are essential to the success of the product. There weren't any stakeholders fitting this category.

Manage Closely

These are the most important stakeholders, as they have high power and high interest in the

product. They have the power to reshape the product according to their interests, producing a product to their needs.

- **Users of the system**

Users of the system are handled by organizing different meetings, held to make sure that their thoughts are taken into account, and that the system is as usable as possible. They are providing knowledge and feedback on system design, in order for it to be as usable as possible.

- **Techno Anthropology Students**

The Techno Anthropology students are handled by having meetings with them discussing how they are able to participate to the system.

Based on the stakeholder matrix, it is clear that the system users are the most important stakeholders for the project. As a result, there will be spent most resources getting in contact with and interviewing these stakeholders. Based on the conducted interviews, the requirement specifications for the system will be made. The other stakeholders will be included in each their way and in varying degree, in the development of the system.

2.3 Regulations of Food Donations

As the product is a web platform with a network of users interacting with one another, and establishing food donations, rules, and regulations concerning facilitating food donations and data protection laws. A great trouble can be made if the regulations isn't kept. For this reason, the European regulations on food donations and data protection will be explored.

2.3.1 European Regulations

As the system will concern food that is meant to be consumed, it is important that the system takes into account that there has to be regulations on the food that goes through the system, to avoid causing harm to the people who receive the food. These regulations are both legal, and operational barriers to the redistribution of safe, edible food across the world. In order to take the regulations into account, the project will regard all the regulations set by the European Union (EU) that concerns food donation and food redistribution.

In Europe, a commission notice of the EU guidelines on food donations from the European Union sets the regulations of food donations across Europe. The purpose of the guidelines is to clarify EU regulations and help lift barriers to redistribution of food within EU. This means that the guidelines aims to facilitate compliance of providers and recipients with the relevant requirements from EU, such as food safety, food hygiene, liability, traceability, VAT, etc. [37]

The guidelines recommend that the regulations are developed at a national level, to set clearer rules and operational procedures for all actors, and the EU guidelines serves as a reference when elaborating national guidance and rules. [37]

However, all involved actors are required to follow the General Food Law, Food Hygiene Package, Food labelling and durability, VAT rules, Official Controls, Waste Framework Directive, Common organization of the markets in agricultural products, Common organization of the markets in fishery and aquaculture products, Common Fisheries Policy Control rules and Fund for European Aid to the Most Deprived. These are the laws that all European actors must abide by, as food donations are considered equal to selling the food. [37]

Any organization that receives surplus food, whether for charity or redistribution, are considered as food business operators under the General Food Law alongside donor organizations. [37]

Food and feed business operators at all stages of production, processing and distribution within the businesses under their control shall ensure that foods or feeds satisfy the requirements of food law which are relevant to their activities and shall verify that such requirements are met. [38, Article 17].

Member States shall enforce food law, and monitor and verify that the relevant requirements of food law are fulfilled by food and feed business operators at all stages of production, processing and distribution. [...] ²⁷.. [38, Article 17]

Article 17 imposes an obligation on food business operators, where they must participate in implementing the food law requirements and verify that the requirements are met. Therefore, they are able to refuse products proposed for donation, which could present a risk for the consumer. This can be products with damaged packaging, too close to the "use by" date, etc. [38]

All food business operators are required to withdraw, recall or notify receivers of food that has been deemed unsafe. Due to this, general traceability is required for any and all donations performed by food business operators, such that records show the foods origin, and/or destination(s) throughout the food supply chain. [38]

Food business operators are required to use a traceability system, such that when a risk has been identified, and the food must be removed, it can be managed in a timely and effective manner. The minimum requirements of information is laid down in article 18, and are as follows. [38]

- name, address of supplier, and identification of products supplied;
- name, address of customer, and identification of products delivered;
- date and, where necessary, time of transaction/delivery;
- volume, where appropriate, or quantity.

The records of the food's traceability must be kept for 2-5 years, depending on the member state's further specification in national rules. The traceability of food distribution to the consumer however, is not necessary, and is only applicable between food chain operators. In the case of fishery and aquaculture products, the traceability must be complemented by a specific

traceability rule set out in article 58, in order to comply with the Common Fisheries Policy. This means that the food business operators must be in possession of specific information that is required when tracing these products. [37]

Actors

The actors that are involved in the food supply chain are each given responsibilities and obligations to their respective part of redistribution of surplus food, laid down by the General Food Law. The actors with their responsibility is as follows: [37]

- **"Donor" organizations**

These are described as a food business, which are able to provide surplus food from each step of the food supply chain.

- **"Receiver" organizations**

These are involved in the redistribution of surplus food, and are separated into two sub-groups; "back-line" and "front-line" organizations, some of which fulfills the requirements for both donors and receivers.[37]

- "Back-line" organizations are food banks that receive surplus food from actors, and then redistribute to a network of affiliated charitable organizations or directly to the consumer.
- "Front-line" organizations receive surplus food from actors in the food supply chain, which they then redistribute to the the people in need.

- **Private donors**

For Private donors, the General Food Law does not apply to primary production for private domestic use, preparation, handling or storage of food for private domestic consumption. Thereby, private donors that provide food to receiver organizations are excluded from any obligations relating the General Food Law. However, Receiver organizations are still abiding by the General Food Law, and are thereby given the full responsibility of the food donation. [37]

- **"Facilitator" organizations**

These are intermediary organizations that may provide a service to enable contact between food donors and receivers, and matching the supply of surplus food with the potential demand. In the case of Information and Computer Technologies (ICT) networks, the owner of the platform is encouraged to draw the actors' attention to their respective obligations under EU food law. In case the facilitator participates in the preparation, handling, storage or distribution of food, the facilitator is likely to be considered as an actor that abides by the EU food laws. [37]

Sorting of food

All food that is placed on market is required to be deemed as safe to eat. Food made up of multiple units, such as a box of oranges, where not all of the oranges are fit for human consumption, the unfit oranges may be sorted out of the box, as long as the rest of the oranges are deemed safe to eat through a detailed assessment carried out by a food business operator. [37]

Therefore, such operations as opening up a net of oranges to separate spoiled fruit from that which is suitable for human consumption – be this carried out by the donor (e.g. retailer) or the receiver (e.g. RO/CO) – is possible as long as, following a detailed assessment, it can be ensured that the food which is redistributed is safe to eat. [37]

This means that a food business operator is allowed to donate unsorted food that may contain spoiled foods, as long as the receiving food business operator sorts the food, such that all the food that is deemed as unfit for human consumption is discarded through the detailed assessment. In order to guide the food businesses on the assessment, EU provides a guidance on implementing the general food law, to help assessing if the food is fit for consumption or not.[37]

Labeling

In EU, all foods are required to be labeled, in order to inform consumers, or end beneficiaries of its contents, such that the ingredients, nutrients, allergens, date of production and date of expiration are present. The information on the label must appear in a language that is easily understood in the member state where the food is distributed, which may require labels with specific languages in certain member states, which could prohibit, or limit distribution across country borders.[37]

Date marking on labels help both food business operators and consumers make optimum use of the food, as well as the length of time the food can be stored under specified storage conditions. The date marking are denoted by two types; "best before" date, and "use by" date.[37]

"Best before" dates are the most common, and indicates how long the food will maintain their optimal condition under their specified storage condition, and thereby relates to when the food's quality is expected to diminish, rather than when the food is expected to be unsafe to consume.[37]

"Use by" dates are used on foods that are highly perishable, and within a short period of time become unsafe to consume. The date relates to the safety of the food product and should always be deemed unsafe after its expiration date. [37]

According to the EU, the product is considered to be an information and computer technology facilitator, and it does not abide under the EU Food Law, as it will not directly handle the food. However, it is encouraged that the platform draws attention to the laws that the donor and receiver organisations abides by, by including the necessary information to food donations, such

as "best before"/"use by" dates, and being able to track the food through the system, in order to oblige by the traceability laws, and that this information is kept for at least 2 years. [37]

The food must also be correctly labeled with the language of the country it is to be distributed, or it has to be stated if the labeling is incorrect, and how the labels are incorrect, in order to provide the necessary information about the food. The product should also encourage that the hygiene while handling the food is kept, to prevent unnecessary recalls, and ensure that the food is up to the standards of consumable foods. [37]

2.3.2 Data Protection Laws

As the system will require personal information from the users of the system, it is essential to protect the data that is in the system in the most responsible way possible. In order to understand what the laws for protection of data are, the EU General Data Protection Regulation (GDPR), provides what must be respected as long as the system is used by EU citizens.

Data protection laws are created to protect people from use of their personal data without their explicit consent. The GDPR is an EU legislation that only applies in EU countries, however, GDPR does not regard where the business is located, but rather who the audience is. If a non-European IT-company's service is available in Europe, the company has to comply with the European GDPR, as it covers every EU citizen and their personal data. GDPR provides a universal definition of personal data, where its application may vary between countries, since it depends what is considered to be sensitive information. For example, in Denmark social security numbers are considered as sensitive information, while in UK, financial data and national insurance numbers are not seen as sensitive.

Personal data must only be processed in a lawfully, fairly, and transparent manner, which states explicitly what the collected data is used for, and only for adequate, legitimate purposes, and is not further processed, such that it is incompatible with the specified purposes. However, further processing for public interest, scientific, statistical, or historical research purposes are not considered to be incompatible with the initial purposes. The data must not be kept for longer than necessary, unless it is not considered incompatible with the initial purposes, as stated in the aforementioned research purposes.

Before collecting personal information, the subject in question must be provided with information regarding what personal data is required, and must give consent to processing their personal data, which must be provable by the IT-service's controller. The subject must have the right to withdraw their consent at any time, without affecting the lawfulness of the processing, and it has to be as easy to withdraw, as it is to give consent. Additionally, the subject has the right to be "forgotten", such that any unused data is erased without delay, or in case there no longer is a legal right to store and process their data.

In case personal data has been obtained from elsewhere than the subject, or is to be passed on to a 3rd party, the subject must be provided with details regarding all possible recipients of

their data, as well as the legal basis for the processing of their information.

It is apparent that the protection of the personal data in the system has a high priority, and must acknowledge the GDPR, in order to be used in the European market. If the GDPR is not kept, the product will not be acceptable for use in EU member states, so any processing and collection of data must be done lawfully, fairly, and in a transparent manner. The users must be given the necessary information about the use of their personal data, and they must give consent to any and all collection and/or processing of their data. In case their data is shared with a 3rd party, this must be disclosed, as well as the extent and content of the data that is shared.

From section 2.3.1 on page 23, it can be inferred that according to food donation regulations, the product will function as a facilitator organization that establishes contact between donor and receiver organizations. The product is encouraged to remind actors of their responsibilities regarding food safety, labeling, durability, to avoid preventable mishaps when using the system. The product must also keep records of the donations performed, to comply with the traceability of foods, and in case of recalls, it must be possible to contact the receivers either through the system, or through other means, by displaying relevant information about the receivers. Each food item must contain a "best before"/"use by" date, such that receivers are able to see when the food expires, and foods with a "use by" date cannot be donated after the expiration date, as it is deemed unsafe for consumption.

From section 2.3.2 on page 27, it can be inferred that protecting the user's personal information is essential, and it must be disclaimed what exact purposes the data will be used for. The GDPR must be withheld as long as EU citizens have access to the service, and its definition of personal data must be complied with. A user must also be able to delete or change any, and all unused data that regards them at any point in time.

2.4 Interviews

As there are no comparable systems on the market, dealing with the communication challenge within the food charity segment, it is important to study potential users in order to meet their known and unknown demands. Therefore, several interviews were conducted in Brazil 2019, prior to this project, with the main goal of gathering information needed to develop a working system.

The interviews had two sub goals: (1) Gather information about current work processes, and (2) Test and get feedback on the prototype developed in [20]. There were conducted 4 interviews with different potential stakeholders. Detailed notes can be found in appendix A on page 83

Hugging the World is a group of volunteers who works towards bettering conditions for homeless people in Brasilia, Brazil. They do this by hosting events where they cook meals, mostly using surplus food, received from various donors. In addition to serving food, they also give toys and clothing, which they have been collecting prior to the event. As of now, the limit

of events they can host, is the amount of food they receive. They have to manually contact donors for every event, through phone and email, which is an extremely time consuming process. When they heard about this IT-system that potentially could free up time for them, they agreed to test the prototype and give their feedback. Key thoughts from the meeting:

- Liked the idea of a website, as it makes it easy to access from different platforms.
- The user interface needs to be redesigned such that it appears more welcoming to users.
- Use the term "organization" and "charity" with care, as there are different perceptions of these words.

Santo Anníbal is an institution that functions as a daycare for children of single mothers. Because of various reasons, there are a lot of single mothers in Brazil, and they are in need of a place that can take care of their kids during the day so they can go to work and earn money. Santo Anníbal houses 300 kids every day, and provides schooling and meals in addition to giving the kids a safe place to be during the day. The institution relies on donation, as it does not receive any kind of public support. Food is donated from private donors through "care packages" and nearby supermarkets donates their surplus food. The organization sees a potential for the IT-system, and agreed to test it. The following key thoughts summarizes their thoughts:

- Generally like the overall concept.
- More inviting interface/layout.
- Needs some kind of notification when an action has been done, that has something to do with each individual user.

R2 Productions is a company in Brasilia, Brazil who organizes some of the biggest parties and festivals in Brazil. They can gather more than 10,000 people to a festival, and naturally this creates food waste. Since R2 Productions is so big, they do not handle the surplus food themselves. Instead, they have a deal with Mesa Brasil, who comes and pick up surplus food. In addition to donating leftover food that intentionally was meant for the participants, they have a concept as follows:

R2 productions allows people to pay half the price of event tickets if they donate 1kg of non-perishable food.

This means that people are bringing non-perishable foods, and the festival ends up with foods that can be donated to socially vulnerable people through the help of Mesa Brasil. Since R2 Productions are not directly involved in the process of donations, a user test was found to be redundant. However, they agreed to take a quick look at the prototype, and key thoughts from the meeting are summarized as follows:

- Layers regarding the amount of food donated and the magnitude of the charities.

- Incorporate a map service in order for the charities to see which ones are the closest.
- The layout of the website needs to be improved.

Mesa Brasil founded in 2003, is a national network of food banks in Brazil, who works towards reducing hunger and food waste. They do this by acting as a link between donors and organizations, both regarding communication but also logistics. In the period of January to November 2018 they distributed 37,000 tonnes of food, helping 1.45 million people every day in 541 cities. Key takeaways:

- Food is a human right in Brazil, and therefore institutions who distribute food do not see themselves as charities.
- Would be nice to have information about the institutions, so the donor knows who they are donating to. Something like how many people they help, do they get help from the government, what kind of institution they are, how they are structured etc.
- There is a lot of rules that has to be followed when dealing with food donations.

The interviews provided information from some organizations and institutions working with challenges regarding the use of surplus food, food waste and donations. The feedback from sources like these are useful since it helps identifying real world challenges the system will - and what it could - encounter. In addition, the interviews provided some opinions and thoughts, from the target group, on possible features for the system and design of the website. This has been taken into account when setting up the requirements for the system.

3 Problem Definition

After analyzing the problem, it is possible to define what the problem actually is. This will be done with different analysis models that reflect different aspects of the problem, namely, a requirement specification, a problem statement, and a system definition. The FACTOR analysis is used to make a system definition by describing each of its elements. A PACT analysis is used to include the users and focus on meeting their requirements and needs, by analyzing the potential users of the system. The requirement specification is made in order to specify which requirements the system should have, and how high each of the requirements is rated. A problem statement is then made in order to specify what the problem is, and lastly the system definition is made, which tells what the system roughly should be like. The problem definition is also used to describe how the problem is going to be solved with the information found up til now.

3.1 FACTOR Analysis

Table 3.1: A table showing the components of the problem.

F	Overview of available food donations, and supporting the transactions of the donations.
A	Administration and management of food donations.
C	The system is being developed on the basis of the requirements from the interviewed stakeholders.
T	Web based platform that is available on all platforms that communicates with an API.
O	User, Donation, Reservation, Food.
R	Management platform for donor and receiver organizations to organize and establish communication between each other.

Functionality

The functionality of the system will focus on establishing the communication between donor and receiver, by creating an overview of the currently available donations, and allowing the receivers to reserve the available donations, along with any necessary information that is required to complete the conveyance.

Application Domain

The system will be used as a platform for administration of a user's donation, such that other users are able to reserve the donation, and thereby establish the process of the donation.

Conditions

The development of the system is outlined through interviews with receiver and donor organizations that helped set the requirements of what the system has to be able to do, in order to be usable.

Technology

The system provides a web-service, to enable access to the system across devices. The web-service communicates with an API, containing all the essential non-UI elements, to enable non-web based services.

Objects

The system will contain user objects in order to contain the personal profile of each user. Each donation and reservation are separate objects that will represent a state of the donation or reservation. Each donation and reservation will contain food objects to represent what type of food the object contains, and the amount of the corresponding object.

Responsibility

The responsibility of the platform is to provide a management service to donor and receiver organizations, such that they can establish the communication between them, and arrange donations with each other.

3.2 PACT Analysis

An essential part of designing an interactive system is to focus on the users of the system, and meet their requirements and needs, in order to achieve a usable system. The system is developed using the human-centered design principles.

To analyze the interactions with the system, the PACT analysis model is used, in order to understand how, and under what circumstances the system will be used. Both the receiver and donor organizations' donation process has been thought out in order to gain an understanding of their activities in their particular context, using their current technologies, and analyzing where and how the process can be improved.

3.2.1 People

The people from the respective organizations that handle the food donations are typically the leaders, or people assigned with dealing with food waste, and are often enthusiastic about reducing food waste. The current methods require quite a long duration of attention, and the process is rather difficult to learn as it requires the people to either remember or write down most of the information on paper. The people are from multiple backgrounds, and varying ages with different experience in both the area of food donations and technologies.

As the system will concern both Danish and Brazilian stakeholders, the platform needs to have at least English and Portuguese language support, as the Brazilian stakeholders were observed as non-bilingual, while the Danish stakeholders were bilingual in at least Danish and English. The cultural differences were not explored enough to draw any conclusions, but there were not found any restrictions apart from lingual differences.

As the system will concern a heterogeneous user group, the design of the system needs to take special needs into account, such as colour blindness, dyslexia, as well as certain degrees of illiteracy. The commitment, or rather interest, of the users has been observed, in the interviews, to be mid to high, while they still are discretionary to the use of the system. The frequency of how much the users will interact with the system is yet to be observed, and is therefore inconclusive.

3.2.2 Activities

When the people use the system, their goal is to either donate food, or to receive food, and is supposed to be used on a regular basis, which means that the system must be easy to use, and with well defined tasks. The system will be able to be used without continuous use, and must relieve current task practices.

The system will be used on an individual basis, while indirectly cooperating with the other users in the system to both actively populate and collect donations. All donations has to be populated with the required information, as well as the foods it will contain, which might be time consuming, but will be the most time consuming process in the system.

3.2.3 Contexts

The system will most likely be used while the users are working, which means the physical environment can vary, depending on the user. However, it is possible to be a stressful environment that can be both noisy and cold, as factories and caterers keep their food in large refrigerated areas. Due to this, a portable, centralized platform would be beneficial, as they would be able to insert the foods into the donations while sorting the food that will be donated, rather than writing it down, to then later enter it into the system.

3.2.4 Technologies

The system will receive input through web-forms, where the user can enter their data with an analog or a digital keyboard. The system's output will be in the form of a web-based UI, on various screen sizes, such as desktop PCs, laptops, tablets or smartphones. The system establishes the communication between stakeholders through an online real-time platform that is available through an URL on the internet. Since the system will be available on the web, and will contain personal information, the security of the system is critical.

3.3 Requirement Specification

Based on the information presented in chapter 2 a requirement specification is defined. The requirement specification is in the form of a MoSCoW analysis, which prioritizes the requirements and splits them into four categories; Must have, Should have, Could have and Won't have. The prioritized categories can be seen in table 3.2.

Table 3.2: MoSCoW analysis.

Must have	Should have	Could have	Won't have
Login	“News feed” - via instagram/facebook/twitter etc.	Statistics of donated food	Prioritization of charities that need food the most
Comply with GDPR	Chat function	Partial reservation	Mobile app
Overview of available donations page	Notifications	List of receivers in a given area	
Add/edit/delete donation page	Front page describing the system	Different categories for donations (not only food)	
Register	Filtered search/Location sorting	Required boxes when registering	
Admin for registrations	Mobile UI	Rating system of users	
Multi language support		Anonymous donation - Request contact information	
Charity can add donation		Pictures with donations	
Multiple accounts			
Exp. /BBF. date			

3.3.1 Must have

The features with the most importance to the system is the abilities to add, edit, and delete a food donation, and reserve a donation through the system. Furthermore, a log-in feature to authenticate is a must have feature, as it helps differentiate between the different donors and organizations.

To make sure the registration of an account is valid, it has to be confirmed by a third party, an admin for registrations, before it is possible to create or reserve any donations. An admin for registrations is required since it has to be valid organizations, companies, charities etc. that are donating and receiving donations, to avoid abuse of the system for personal use.

For the system to work, it is required to have an overview of available donations, and since the system is supposed to work globally, it is required to handle multiple accounts and language support for multiple countries. Furthermore, it is required for the system to comply with the GDPR and ensure encryption of sensitive information. Lastly, it has to include the specific expiration dates or best before dates of the specific foods to ensure the food is donated and consumed before a potential expiration date.

3.3.2 Should have

Charities should be able to filter the search for available donations, through categories, such as meat and dairy, and location-based filtering, so it is possible to search for the donations closest to the charity, to make sure the specific charity are not looking at available donations from across the country.

A chat feature should be a part of the system, since stakeholders and interviewees desired a fast way to communicate with the donor and vice versa, together with a notification, as an example an e-mail, when a food donation has been reserved and a notification when the reservation have been confirmed.

To attract more users, since the system demands a large user-base to work properly, it was mentioned in the interviews in section 2.4 on page 28 that a welcoming layout was needed when presented with the UI. Furthermore, it should include a form of news-feed feature so it is possible to see the latest confirmed donations, since both of these are desired features found through interviews. According to the aforementioned interviews with stakeholders, the system is likely to be used on smartphones, therefore it should be easy for the mobile user to understand and and navigate through the system with a user-friendly mobile user interface.

3.3.3 Could have

A desired feature for the system is a way for the user to know exactly what information is necessary to enter, for the system to create a user account which could be an asterisk (*), as an indication that the field is required to complete the registration.

Another possible feature to implement in the system is the option to make partial reservations of donations, but since the size of donations are unknown and it is not a necessary feature for the system to work, but more of a feature for further development, it is not likely to be part of the system. Another feature, which have been requested, is a rating-feature for the system. In this rating-feature, it should be possible for both the donor and the recipient to rate each other according to the donations made in between.

Additionally, a way to make anonymous donations have been requested, since it might not be everyone who want to know exactly who donated food to whom. Following this feature, it should be possible for the user to request the user information of the donor, meaning that the donor can either reject or accept the request made by the recipient. Since a way to be anonymous

is not a necessary option for the system to function, it is unlikely to be implemented into the system at the current state.

Another desired feature, that could be a part of the system at a later state, is a list of receivers in a given area. This could be accomplished using features like Google Maps by Google. This is a possible expansion on the filtered search feature.

The last features of the could have category are statistics on donated food, which is a feature that illustrates how much of each type of food that have been donated. Possibly it could also show what kind of food a specific user are either donating or receiving the most of. Since this has no connection to the purpose of a food redistribution system, it is most unlikely to be a part of the system.

3.3.4 Won't have

The system won't have a prioritization of charities that need food the most due to the complexity and ethical questions on how to prioritize the need for food.

A mobile application will not be developed due to the fact of the existence of multiple mobile operating systems. This means that multiple applications will need to be developed, or an analysis of mobile operating system prevalence of potential users will be needed before developing any application. It was therefore decided to not look further into the development of a mobile application in this project due to prioritization of resources.

3.4 Problem Statement

Through the analysis in chapter 2 it has been established, that food donations are handled manually through phone calls. The requirements for an IT-system able to coordinate food donations has been defined based on interviews and research to ensure a functional system. Based on this, the following problem statement has been defined:

How can a globally applicable IT-system that facilitates communication between charities and organisations, thus simplifying food donations, be developed?

3.5 System Definition

The system is a marketplace where organizations can donate food to charities, whereof different charities can claim the donated food. It is supposed to be used internationally and will therefore support multiple languages. It must also be intuitive to use and be usable by mobile devices.

4 Problem Domain Analysis

The problem domain analysis is done because after defining the system, the problem domain has to be limited and described. The problem domain is the part that is administered, monitored, or controlled by a system. The analysis contains three sections; classes, events, and state chart diagrams. Classes is used to describe the different part that a model contains. Events is used to show which classes that are affected when an event occurs. The state chart diagram shows the different states that objects can be in, and shows the transition between the different states.

4.1 Classes

In this section the general structure of the system will be explained. The system is "based" on four classes user, donation, reservation, and food and can be seen in figure 4.1.

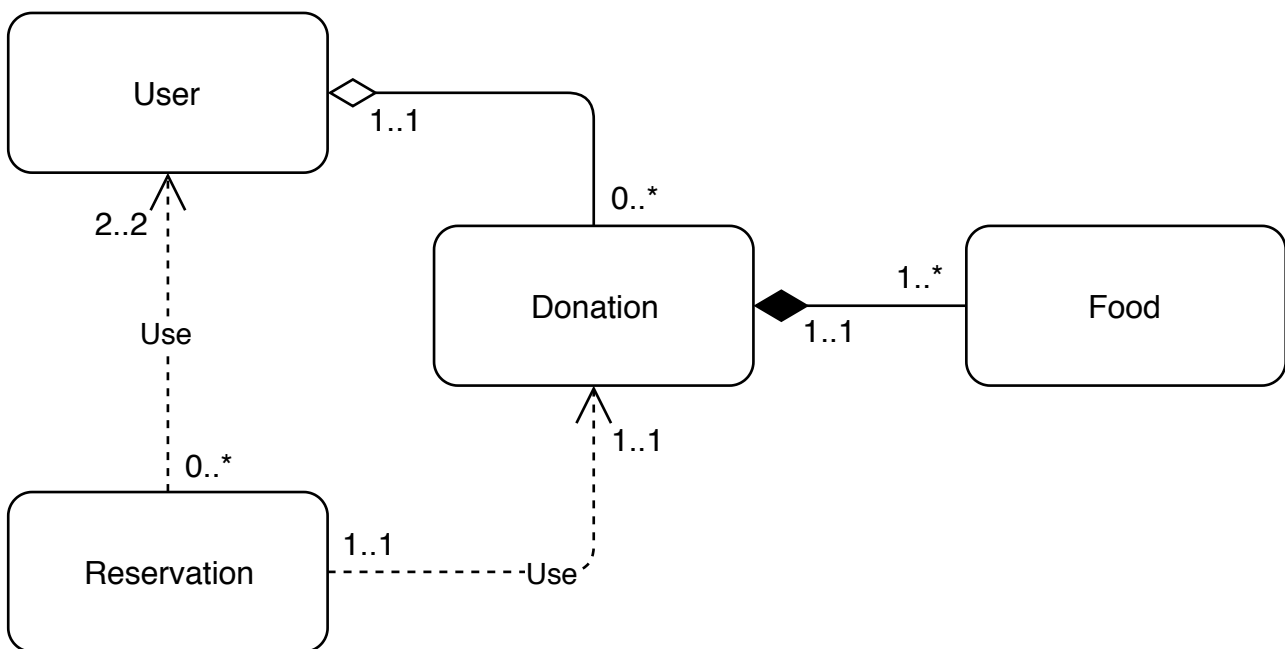


Figure 4.1: Simple class diagram showing the classes and their relationships and multiplicities.

User is used as a class for the users of the system. This class is not dependent of any other classes i.e. a user can exist without a donation and/or a reservation. The multiplicity for user to donation, and for user to reservation, is "zero to many" which means that a user doesn't need donations or reservations but can have unlimited of them.

Donation is used for creating donations consisting of food. This class will depend on the user class, as it cannot be created without a user, but it can exist on its own. The multiplicity

for `donation` to `food` is "one to many", as a `donation` must have at least one `food` object and can contain an unlimited number of `food`. The multiplicity for `donation` to `reservation` is "one to one", because a `donation` can only have one `reservation`.

Food is used to specify what kind of foods that can be added to a `donation`. It is a "one to one" multiplicity with `donation`, because a `food` object can only be added to one `donation` and can only exist if there is a `donation`, but there can be an unlimited amount.

Reservation is both dependent on the `user` and `donation` classes. A `reservation` can only exist with one `donation`, and needs two `users`.

4.2 Events

In this section the events in the system are presented and some described further. The + sign is used for describing a single object getting affected, and an * sign is describing an arbitrary amount of objects getting affected. The events occurring in the system can be seen in table 4.1.

Table 4.1: Event table showing what classes gets affected by an event.

Classes \ Events	User	Donation	Food	Reservation
DonationCreated	+	+	*	
DonationEdited		+	*	
DonationDeleted	+	+	*	
DonationExpired	+	+		
DonationReserved	+	+		+
ReservationCancelled	+	+		+
ReservationAccepted	+	+		+
ReservationRejected	+	+		+
DonationSearched		*	*	
FoodAdded		+	+	
FoodRemoved		+	+	
UserCreated	+			
UserEdited	*			
UserDeleted	+			

Some of the events are explained further since it is not clear what happens from their name alone.

DonationExpired occurs when the earliest expiration date of a food from a donation, which is when the expiration date of the donation itself, has passed. The donation will then be removed from the system.

DonationDeleted and **ReservationAccepted** end a donation, but in different ways. **DonationDeleted** occurs if a user removes a donation that they made themselves, while **ReservationAccepted** occurs when the user who owns the donation, has accepted the reservation made by another user and the donation proceeds.

DonationSearched occurs when a user searches for a donation using the filtered search option. It could be wide searches with one search option enabled or more specific searches with multiple search options enabled.

UserDeleted happens when a user wants to delete their profile from the system, all the donations made or received will then say that they are made by an unknown user.

4.3 Statechart diagrams

An object of a class can have different states in its lifetime. An action is taken in order to create the object, and put it in a state. Different actions can then change the state of an object or smaller objects inside the object. An action is then made to either delete, or make the object irrelevant, meaning that the object’s lifetime is over.

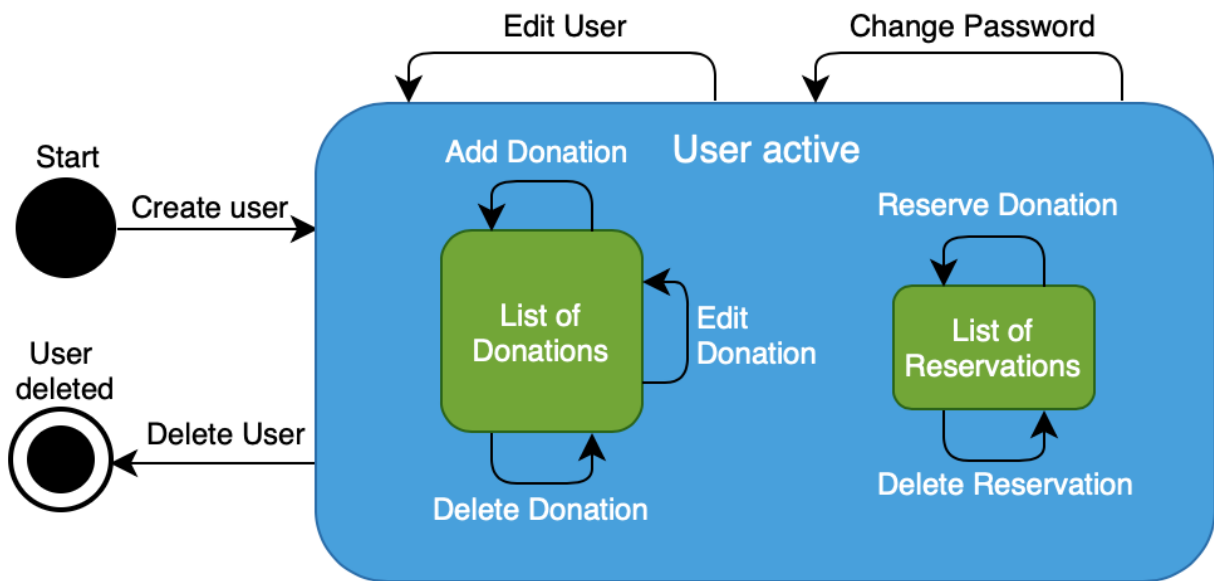


Figure 4.2: A statechart diagram showing the states of user.

Figure 4.2 on page 39 shows the state of a user object during its lifetime. The object starts when a user is created, which puts the user in an active state. A user can then get edited and have its password changed. This changes what the user contains but doesn't change the state of user.

Inside the user are two smaller objects; list of donations and list of reservations, which are made along with the user. List of donations is the donations that belongs to a user, and can't have its state changed. The list of donations can be changed by changing a donation inside the list, by either adding a new donation, editing a donation, or deleting a donation. The list of reservations is a list of reserved donations and can't have its state changed either as the list will always remain even though it's empty. The list of reservations can be changed by either reserving a donation or deleting a reservation.

If an action is made to delete a user, it is going to be deleted alongside with the list of donations and list of reservations.

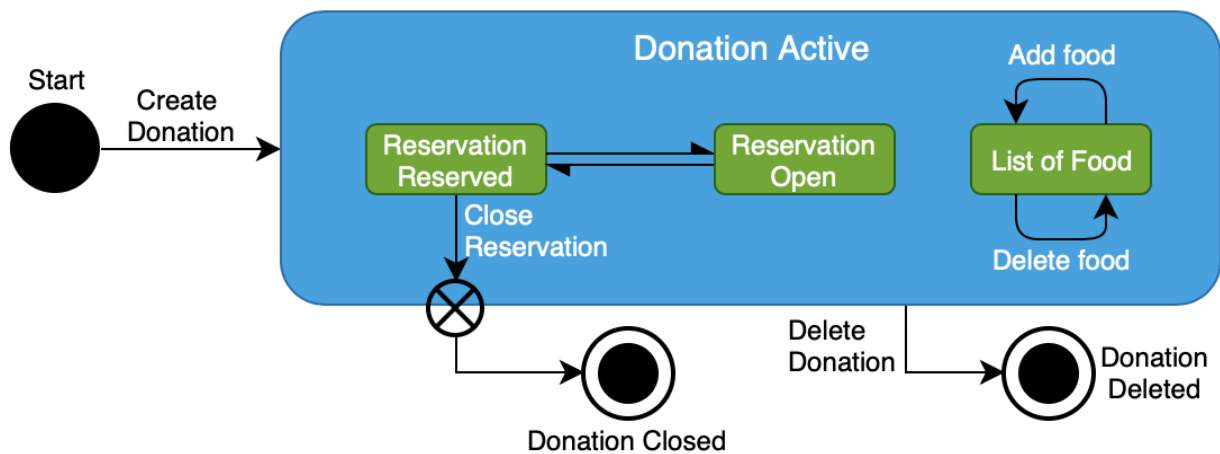


Figure 4.3: A statechart diagram showing the states of donation.

Figure 4.3 shows how a donation object looks like and its life cycle. When a donation is created it will get to the state of being active. Inside a donation object there are three smaller objects, with two of them depending of each other. A list of food can't have its state changed, but the content can get changed by either adding or deleting a food object. A reservation inside a donation can have two states; either reserved or open. If a reservation is reserved it can get changed to open and vice versa. Also when a reservation is reserved it have the option to get closed. This will be done when a donation has been delivered to the user who reserved it. This will delete the donation object, yet the donation object can also be deleted by manually deleting it.

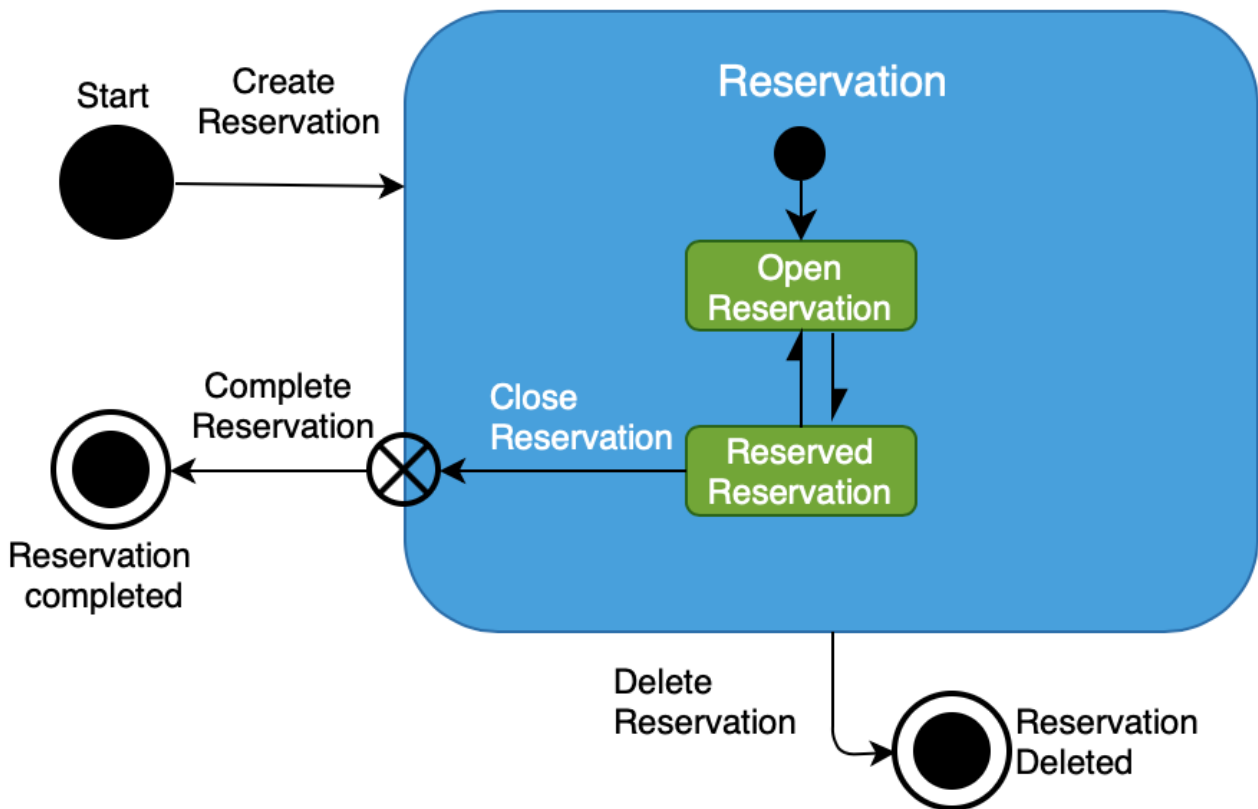


Figure 4.4: A statechart diagram showing the states of reservation.

Figure 4.4 shows how a reservation object has its states changed in a life cycle. Whenever a reservation object is created, some smaller objects are also made; Open reservation and reserved reservation. Open reservation is getting initialized when a reservation is created, meaning that the reservation hasn't been claimed. When a reservation is getting reserved the state changes to reserved donation. This can be changed back to open in case of a user changing their mind. When a reserved reservation is done getting delivered the reservation object will get irrelevant and it will end its life cycle.

An action can also be made to delete a reservation, ending its life cycle.



Figure 4.5: A statechart diagram showing the states of food.

Figure 4.5 shows the creation of a food object. A food object is created whenever an action is made to create a food. Food only has one state which is created, since it only belongs in a list of

food in figure 4.3. When an action is made in order to delete a food, the food object is deleted.

5 Application Domain

The application domain should be analyzed in order to know how the final iteration of the system should be. This is done by using rich picture, use cases, interfaces, and functions. A rich picture is made in order to show how the system will work once it's done. Use cases is created in order to see what possibilities the different actors have when using or managing the system. Interfaces is used to show what the natural flow of usage of the system would be for a new user. The functions will be found in order to find the different things that a user can do on the system, and to see what type the functions have, which makes the development of the system a lot easier.

5.1 Rich Picture

To help understand use cases, a rich picture showcasing the system in use has been created.

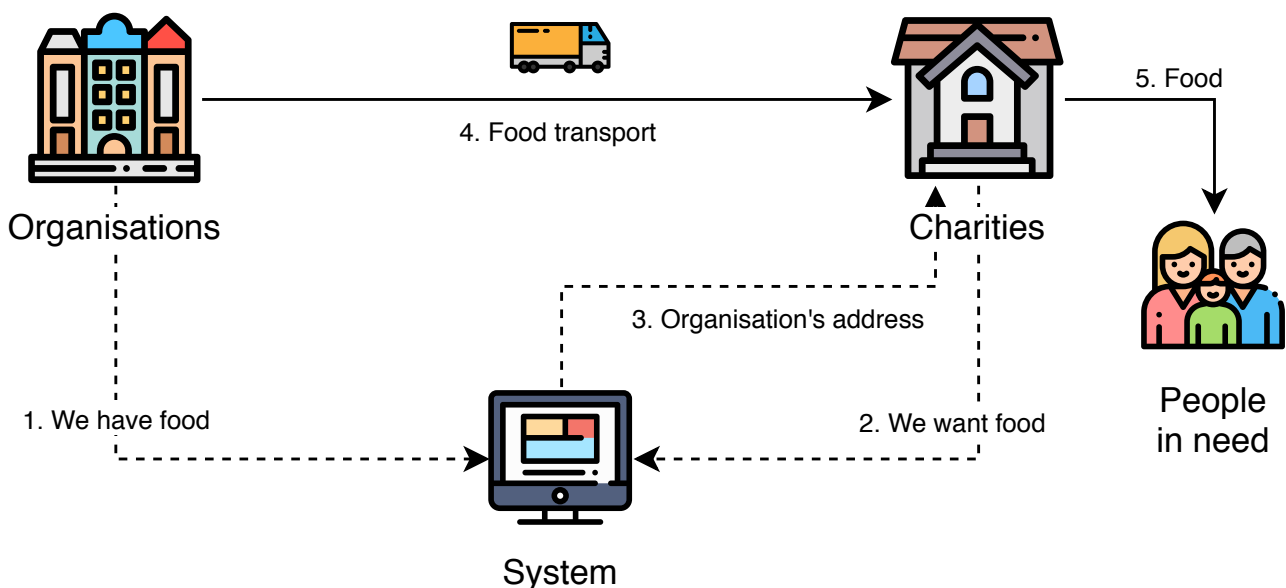


Figure 5.1: Rich picture showcasing the system (similar to figure 1.7 on page 10). [20]

Figure 5.1 shows the different steps involved in a food donation when donated through the system. The first step is, that an entity with food on its hand posts a donation on the system. When a donation has been posted, a charity can reserve aforementioned donation. This makes the system show a pick-up address defined by the donating entity, so the charity can see when and where to pick up the food. The charity can then orchestrate the pick up of the food, before the charity can give the food to people in need.

5.2 Use cases

By finding the actors relevant for the project and determining their use cases, the interactions between users and the system can be determined. Also what features the actors have on the system is shown. The results will be used during the development phase of the system.

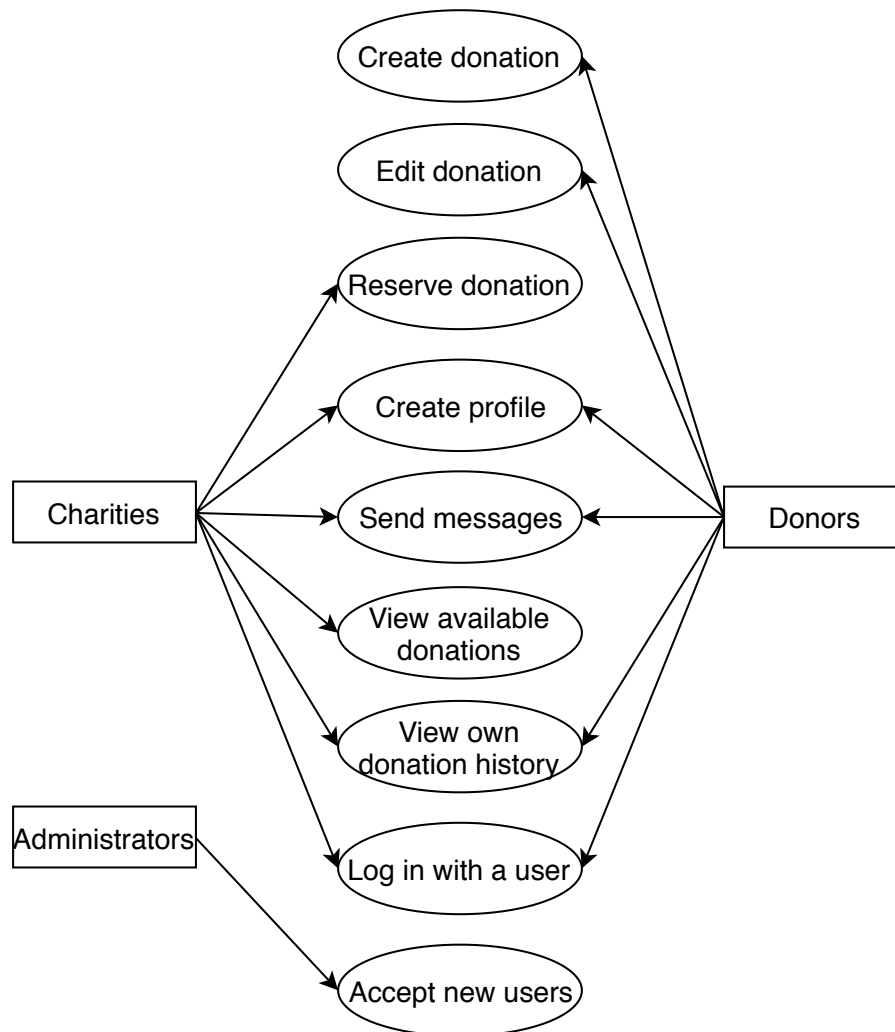


Figure 5.2: Use case diagram showing what actors can do.

Charities are able to create an account, but have to wait for a confirmation and accept from an administrator. After the charities are logged in, they are able to view all the available donations made by the donors. If a donation seems interesting, they are able to get in contact with the donor by sending messages the donor then can reply to. Otherwise, they can reserve the donation to ensure a donation only has one recipient. When the donation has been delivered, the donation will be viewable through a donation history.

Donors can create an account, but similarly to a charity they have to wait for an administrator to accept the creation. When logged in, they will be able to create donations and post them to the system. They will also be able to edit the donation after posting it and communicate with

charities, who have reserved their donation, through messages.

The administrators will manage new account on the website, to prevent spam accounts and abuse of the system, such as avoiding regular people claiming the food that are supposed to go to charities.

5.3 Interfaces

The system is made to be used for routine tasks. As a result, it is very important to make the user interface in such a way, that the user can quickly perform the needed tasks. In order to make the navigation between pages as easy as possible, a navigation bar at the top of the page will be used, which will be able to access all essential pages. The navigation diagram in figure 5.3 on the next page shows the natural flow of using the web site when a user uses the web site for the first time.

Figure 5.3 on the following page shows how a new user most likely will use the web site. The user starts at the `Front` page without login where the user has some different choices to pick from, depending on what they want to do or know. If the user wants to know more about those who runs the web site, they can access the `About` page.

If they have some questions about the web site or system, it is possible to contact the people behind the web site at any time through the `Contact` page. However if they want to create an account, the `Register` page will be the next step. After creating an account, the `Front` page with login will appear. It looks like the other front page but with some more options available in the navigation bar.

From here the user will probably go one of two ways. Either to the `Add donation` page or to the `Available donations` page. If the user wants to create a donation, the user will open the `Add donation` page. When a donation has been created, the user is able to see all the donations the user share, either outgoing, reserved, or completed donations, on the `My donations` page.

If the user want to see all available donations, it is possible through the `Available donations` page, placed in the navigation bar. If the user finds a posted donation interesting, the user has the option to see all the information and have the opportunity to reserve a donation through the `Donation info`.

5.4 Functions

When finding the functions of the website, the navigation diagram is looked upon in order to see what functions that is shown and where they are used. After finding a function, the function type will be determined amongst four different types. Update is when data is sent or received to/from the web site. Signal is when a function can check data to see if something is wrong and then give a signal or a warning when that happens. Read is when the user wants to see some

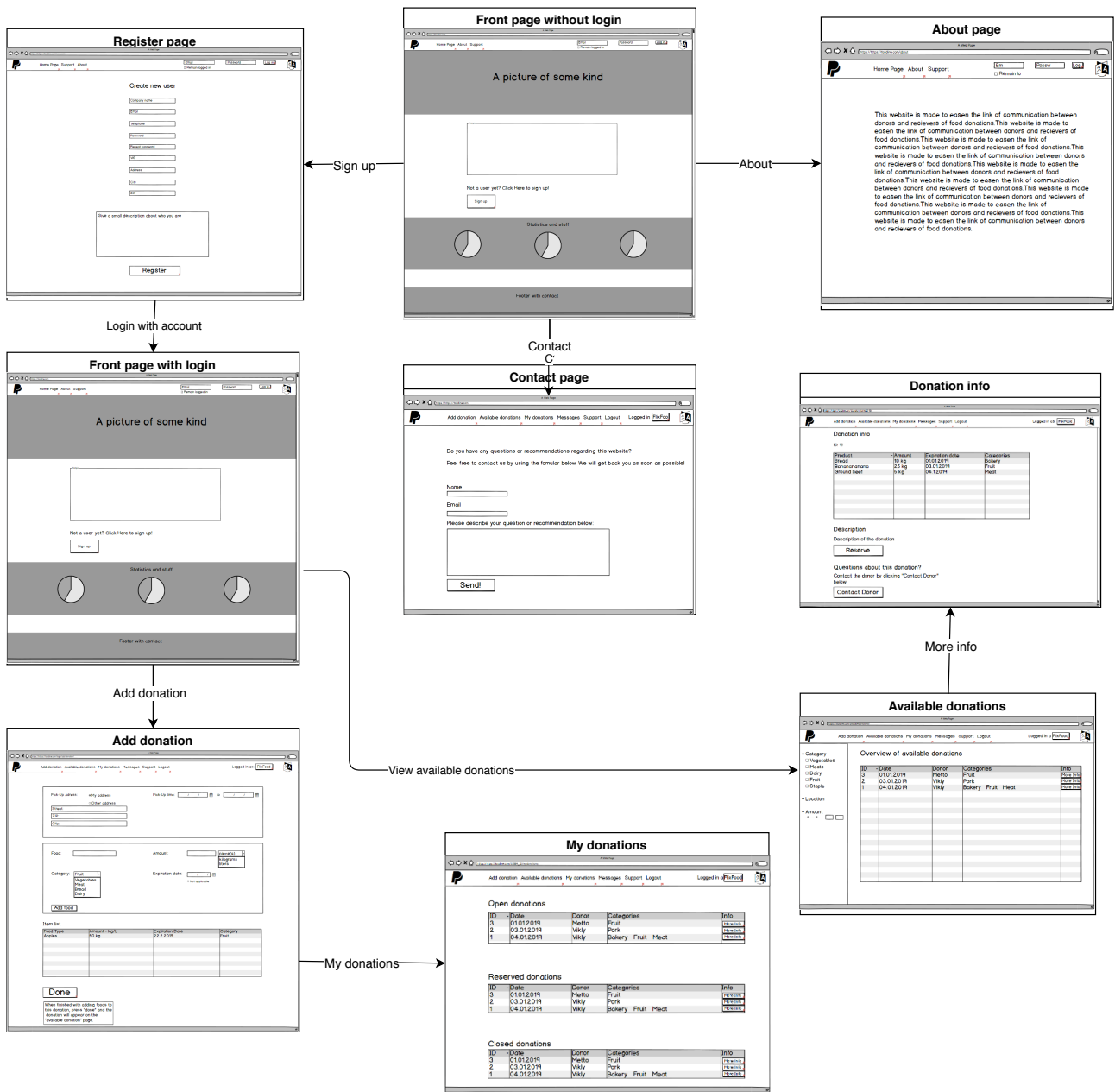


Figure 5.3: A navigation diagram showing the natural flow of interaction on the web site.

information and the system finds that information and shows it. Compute is when the system has to make some kind of calculation or use an algorithm in order to predict or find something specific.

Table 5.1: A table showing the type of the functions.

Function	Type
Register	Update
Edit profile	Update
Change password	Update
Login	Update
Logout	Update
Add donation	Update
Edit donation	Update
Reserve donation	Update
Donation filtering	Compute
Donation info	Read
Contact	Update

The functions found in table 5.1 belongs to different places on the navigation diagram.

Register is used on the register page and makes a new user able to create a new account. Edit profile is not shown on the navigation diagram but could be put on a profile page along with change password. These functions makes the user able to change profile information and the password used to login. Login is used when the user isn't logged in, and makes the user able to log in with e-mail and password. Logout is used when the user is done with a session of website usage. Add donation is used on the add donation page when a user with some spare food wants to create a donation for others to pick up.

Edit donation is used on the donation info if the user is looking on their own donations. Reserve donation is used on the available donation page, whereof the users can reserve donations that other users have made. Donation filtering and donation info is also used on the available donations page whereof donation filtering gives the opportunity to sort through the different kinds of donations. Donation info shows detailed information about each of the donations. Contact is used on the contact page to get in contact with the administrator of the website.

Finding the functions makes it possible to start with the development of an IT-system, because the functions tells what features is going to be on the website. The function types were found, whereof implementing the functions will be a lot easier since the type helps with understanding how the functions work.

6 Development

Through the information gathered in previous sections and the delimitation made in section 3.3 on page 34 a system was developed. It was found that a web User Interface (UI) that was also adaptable to mobile phone browsers would be the highest priority of UI. Moreover, it was found that the possibility of multiple UIs other than Web browsers could be beneficial or even necessary for the system. Therefore, an Application Programming Interface (API) was chosen as the connector to system's data storage, which would also enable the possibility of connecting multiple UIs to the data storage, see figure 6.1.

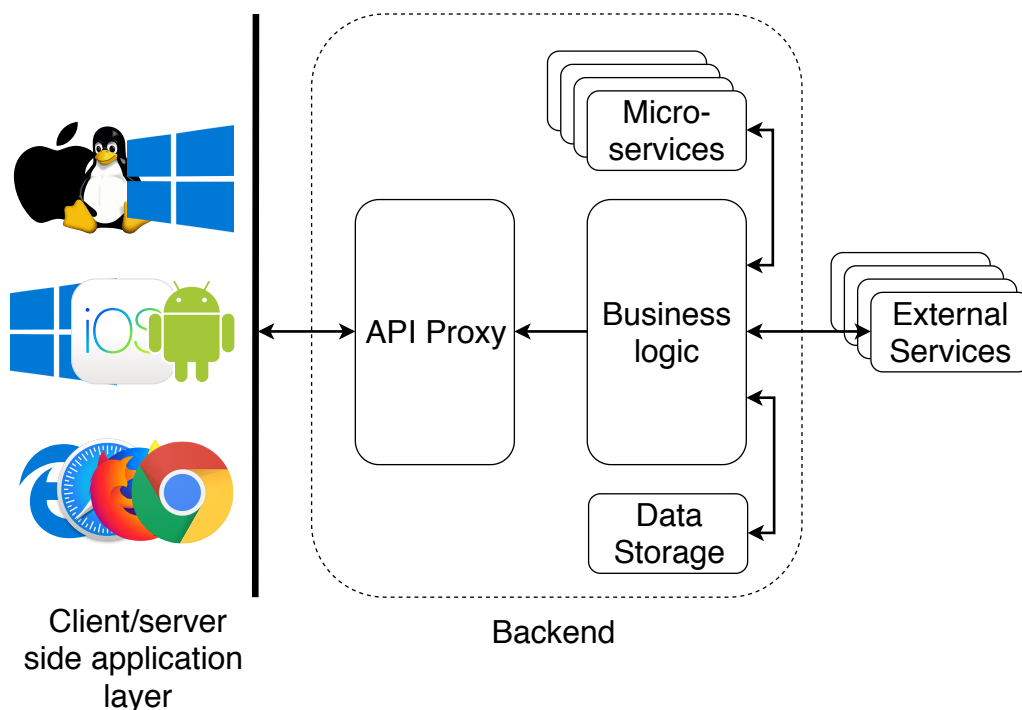


Figure 6.1: The architecture of the system.

The figure above shows an internal structure of how the system is imagined with extra functionalities. Client/server side application layer is the different web browsers, the computer operating systems, and the mobile operating systems. The back-end consists of four things; an API proxy, business logic, data storage, and micro services. An API proxy is what gives the access to parts of the system depending on the authority of the user. The business logic sets the rules in how and what data can be created, stored, and changed. Data storage is how and where the data is stored. External services include third party services such as social media embedding e.g. Facebook login. In this project external services was not used due to low prioritization compared to other features.

The system classes from figure 4.1 on page 37 shows how the classes were thought out earlier,

but now that some more have been analyzed, the classes can get expanded upon. This can be done by creating a class diagram showing the relations between the classes, and their attributes and functions.

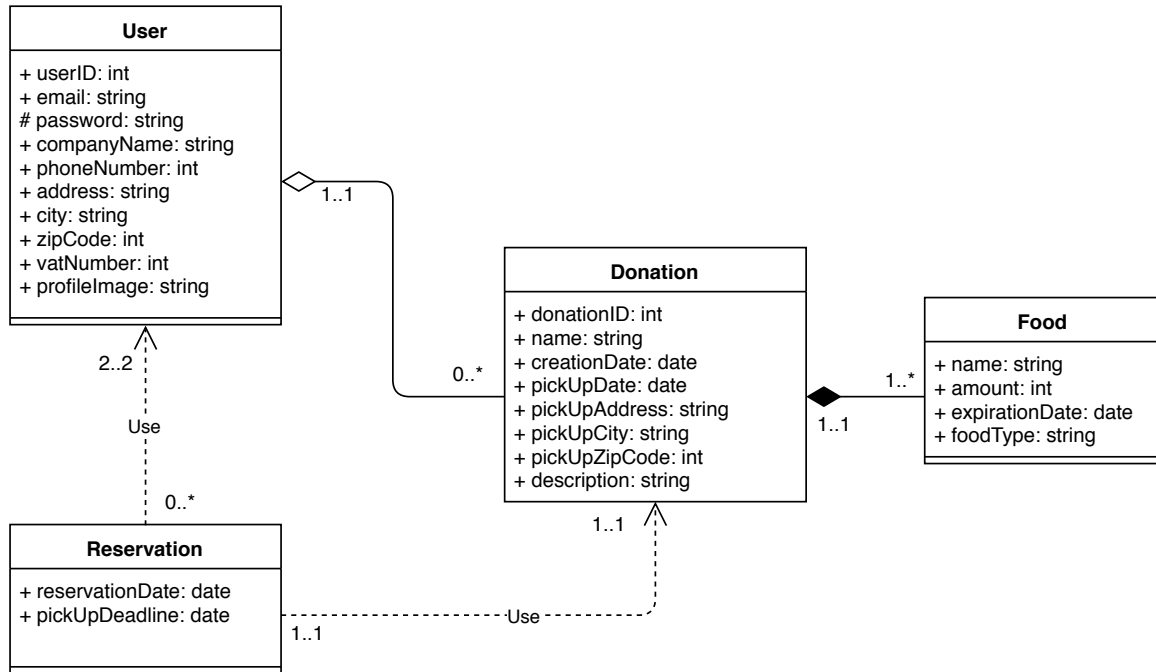


Figure 6.2: Class diagram showing the classes and their relations.

User is the class highest in the hierarchy of the classes. This means that the child classes can't be created without a user being made first.

First off the user needs an ID in order to distinguish between the different users. Email is used for the user to be able to have a way to log in, and to make other companies able to make contact. The password is a hidden attribute that is used by the users to make sure that they are the only ones having access to their accounts. A company name is used because it is assumed that the users creating an account are companies. The phone number is, like the email, used to make contact to a user.

An address, city, and zip code is used when filling the address to where a donation can get picked up. The VAT number can be used to make sure that a company creating an account is a real company. A profile image is used for the users to upload an image, and other users to see when looking at the donations.

User types isn't differentiated between because of some users both creating donation and receiving donations.

Donation belongs to the user class, whereof a donation is made by a user and containing one or more foods. The name of a donation is like a headline for all the foods in the donation. A

creation date is made to make it possible to know when a donation is created, whereof the users are able to see if a donation is too old. The pick up date is a lot like the pick up deadline in reservation, but the pick up date is not as strict as the pick up deadline.

The pick up address, city, and zip code is used for knowing where the donation can get picked up, most useful if it is not at the company address where the donation can get picked up. A donation description is used if the users want to share more information about the donation, than already available.

Food is connected to a donation, and a donation can consist of more than one type of food, depending on the different kinds of food that is included. A food should therefore have a name to separate the different kinds. An amount in order to know how much food is available for donation. The expiration date of the food is highly important because of the regulations on food expiration when making a donation. The food type is made in order to be able to put the food in different categories.

Reservation is used when a donation is getting reserved. Therefore this class is related to user and donation. The donation will then be connected to a reservation date and a pick up deadline depending on the date that the user reserves the donation, and the date that the donation has to be picked up.

6.1 Back-end

The back-end consists of the Database and Web API, which handles e.g. data storage or server-sided processing.

6.1.1 Database

The structure of the back-end system is build upon a database server which is used to store and retrieve data. In this project MySQL, which is an open-source database management system, was chosen due to it's prevalence and documentation. The MySQL server is hosted locally on the same server as the web server which gives faster response time than it would if it were to be hosted on a different server.

Structured Query Language (SQL) is a programming language for relational database management systems (RDBMS), which is the one used in this project through Python libraries and frameworks. The database consists of multiple tables where in each table there are rows and columns. In RDBMS terminology column is also known as either attribute or field, which represents what kind of data is stored in the cells in that column e.g. "E-mail". Rows is also known as either tuple or record, which represents the data that is stored.

The benefits of using RDBMS is the possibility of having foreign keys which represents fields of other tables.[39] An example of this could be having a table called *person* and another table

called *characteristics*, a record in the latter table could then be used as a field in the *person* table.

This project utilizes Django models to make queries to the database. An example of a table can be seen below:

```

1 class Food(models.Model):
2     name = models.CharField(max_length=100, null=False)
3     amount = models.CharField(max_length=100, null=False)
4     expiration_date = models.DateField()
5     food_type = models.CharField(max_length=100, null=False)
6
7     donation = models.ForeignKey(Donation, related_name='foods', on_delete=models.CASCADE,
    ↪ null=False, default='')

```

Code-snippet 6.1: Example of a Django model.

In the code-snippet 6.1 an example of how food items is stored in this project is given. The class is the table name and each attribute in the class is a field in the table. The attribute donation is a foreign key which links the food to the donation class. Moreover, because of the parameter in the foreign key method called *null* is set to false, a donation can not be created with out any food items. All queries on the database happens through the Django models in this system. A figure of how data is either retrieved or passed to the database can be seen in figure 6.3.

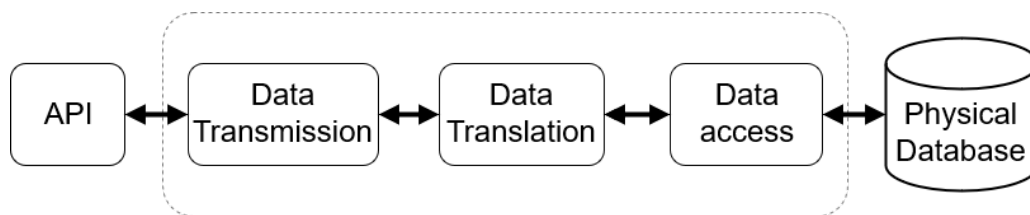


Figure 6.3: Structural overview of data communication with the database.

Figure 6.3 shows that data is being parsed internally, that is data transmission, translation and access, which is handled through various libraries in both third-party frameworks and Django. The data passed to the API is in JavaScript Object Notation (JSON) format and in order for the database to understand the data it needs to be parsed to SQL, therefore there is a translation step in-between the two.

6.1.2 API

The API in this project act as the bridge between the database and the user interface. Furthermore, it eases the access for building different UI's e.g. mobile application. The web API is build with REST framework, which is a toolkit made for Django, and the reason for choosing REST framework is due to it's easy implementation of authentication and serialization of HTTP requests.

The API gives the possibility of using different HyperText Transfer Protocol (HTTP) methods to either send, retrieve, or change data on the database. The HTTP methods used in this project is: *Get*, *put*, *post*, and *delete*.

- The *get* method is used to retrieve data, in the format of JSON, from the database, either a single record or a whole table.
- The *put* method sends data to the database and either creates a new record or replaces existing.
- The *post* method is used to both create new records, e.g. user, and manipulate data in a record.
- The *delete* method removes single records.

All request methods is with HyperText Transfer Protocol Secure (HTTPS) which is an extension of HTTP which secures the connection. In this system the security protocol used is TLS (Transport Layer Security), and is therefore also known as HTTP over TLS. This means that all data is encrypted and therefore makes it more secure from man-in-the-middle attacks [40]. The certificate used for HTTPS is Let's encrypt which is a non-profit organization that provides x.509 certificates free of charge [41].

An API is constructed of multiple end-points which is the url where the request method is called. In this project all database tables and each record in it has its own end-point that is e.g. for the table *food*: `https://hostname/api/food` and for a single record it is the *id* of the record with a trailing slash i.e `url/id/`. The python library **Requests** was used to handle all HTTP requests and responses to the API. The reason for using **Requests** was due to the ease of implementation, an example of mentioned implementation can be seen in code-snippet 6.2.

```
1 response = requests.post(url, headers=headers, data=dataToJson, timeout=5, auth=("username",
  ↳ "password"), verify=False)
```

Code-snippet 6.2: Example of a request.

The above example is a *post* request and due to the fact that this is almost the same approach for all methods, each parameter will be explained below:

- **url:** The end-point where the post method will be used.
- **headers:** Headers contain information that could be required to establish a connection, in this project both content-type and cache-control was respectively set to "application/json" and "no-cache".
- **data:** Is the data that needs to be posted to the database in the format of JSON.
- **timeout:** The maximum amount of seconds that the system will use to execute the request. If the request takes longer than the defined timeframe, the function will time out.
- **auth:** The username and password of the authentication used in the system.

- **verify**: Disables verification of the http connection, due to the fact that the requests and responses is handled locally and therefore don't need to be verified.

As previously mentioned, a HTTP authentication system is applied in the REST framework API. In this project HTTP Basic Authentication is used, which checks every HTTP request for credentials and try to match them with authorized users in the system. If a HTTP request either does not include or have the wrong credentials it will get the response: HTTP 401 Unauthorized or HTTP 403 permission denied.

The purpose of the API is allowing the possibility of multiple UIs and a figure of how the usage of it for the Web UI can be seen in figure 6.4.

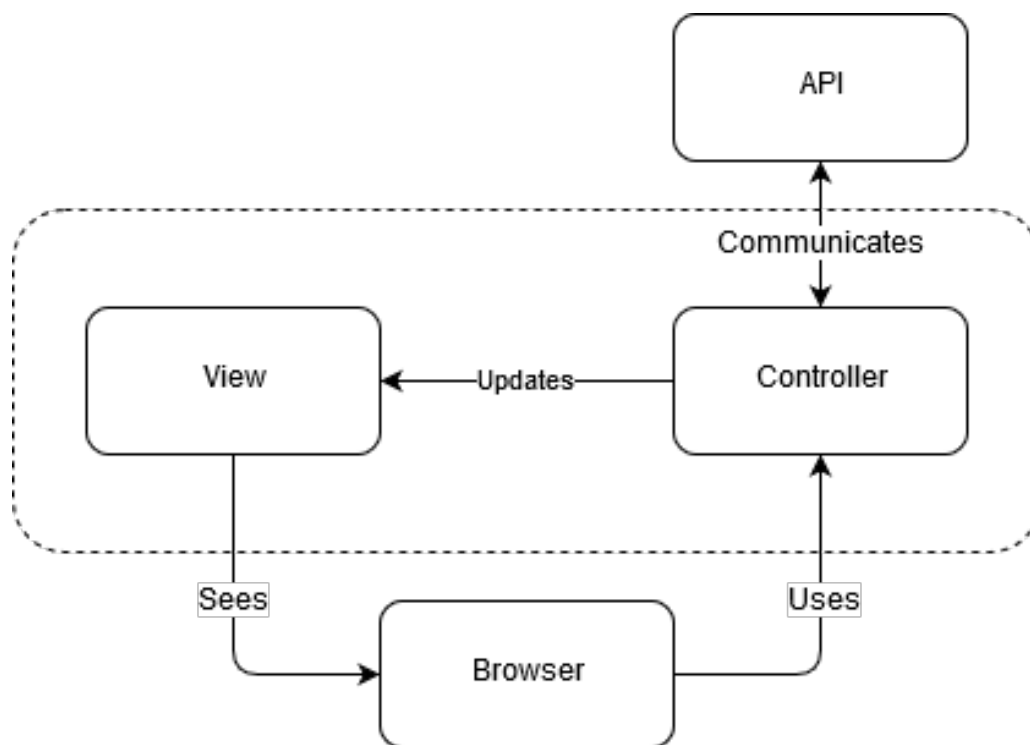


Figure 6.4: A diagram showing the usage of the API in a Web UI.

In figure 6.4 it can be seen that the front-end **controller** communicates with the API, this could be e.g. a donation added. This data would then be validated and sent to the database after which the **browser** will be updated and the **view** will deliver feedback to the user of either success or error.

API Proxy

API proxy helps securing the system, by determining what is exposed to the front-end controller. An example of this can be seen in code-snippet 6.3.

```

1 | class DonationsSerializer(serializers.HyperlinkedModelSerializer):
2 |     foods=FoodSerializer(many=True, read_only=False)
3 |     user_id=serializers.IntegerField()
  
```

```

4     class Meta:
5         model = Donation
6         fields = ('id', 'name', 'user_id', 'creation_date', 'deadline_date', 'pick_up_date',
↪ 'pick_up_address', 'pick_up_city', 'pick_up_zipcode', 'foods')

```

Code-snippet 6.3: DonationSerializer - API Proxy.

In code-snippet 6.3 on page 53 the class `DonationSerializer` is shown and is used whenever the system calls the **Donation** end-point in the API. The serializer both handles translating data formats from JSON to a format the database models understand, it also specifies what fields that is required and which ones can be changed and stored.

Business Logic

As seen in figure 6.1 on page 48 business logic is a connection between the API proxy and the data storage, external services and micro services. Business logic is a term in software development that defines the business rules which handles what and how data can be changed, created and stored. As previously mentioned the API contains multiple end-points and an example of how business logic is used for the donations can be seen in code-snippet 6.4. This is the end-point if the system calls a specific donation record, in the example the business rules of mentioned records are set. This means that the system can only retrieve, create, update, or destroy a record.

```

1     class DonationsDetail(mixins.RetrieveModelMixin, mixins.UpdateModelMixin,
↪ mixins.DestroyModelMixin, generics.GenericAPIView, mixins.ListModelMixin):
2         queryset = Donation.objects.all()
3         serializer_class = DonationsSerializer
4
5     def get(self, request, *args, **kwargs):
6         return self.retrieve(request, *args, **kwargs)
7
8     def post(self, request, *args, **kwargs):
9         return self.create(request, *args, **kwargs)
10
11    def delete(self, request, *args, **kwargs):
12        return self.destroy(request, *args, **kwargs)

```

Code-snippet 6.4: DonationDetail - Business Logic.

Since it is a middle tier component in the architecture it also handles calculations and potential server sided processes. An example of how business rules and API proxy differs could be a user changing password. The business rules requires the current password in order to validate it, however the API proxy does not send the password for security purposes. An action like changing password is therefore handled internally by Django.

6.1.3 Micro Services

The micro services contain all the functionalities in the system, as independently deployable and therefore loosely coupled with the rest of the system. This ensures that the system is highly

maintainable and testable, and that all the capabilities of the system are organized as individual elements in the system. The micro services are accessed through the business logic module, and simply compliments the business layer with functionalities. The business layer determines **which** objects can be created, stored and altered, while the micro services handle the **how**, this is "outsourced" from the business layer in this project. The loosely coupled relation between the micro services and the business logic can be seen in figure 6.5.

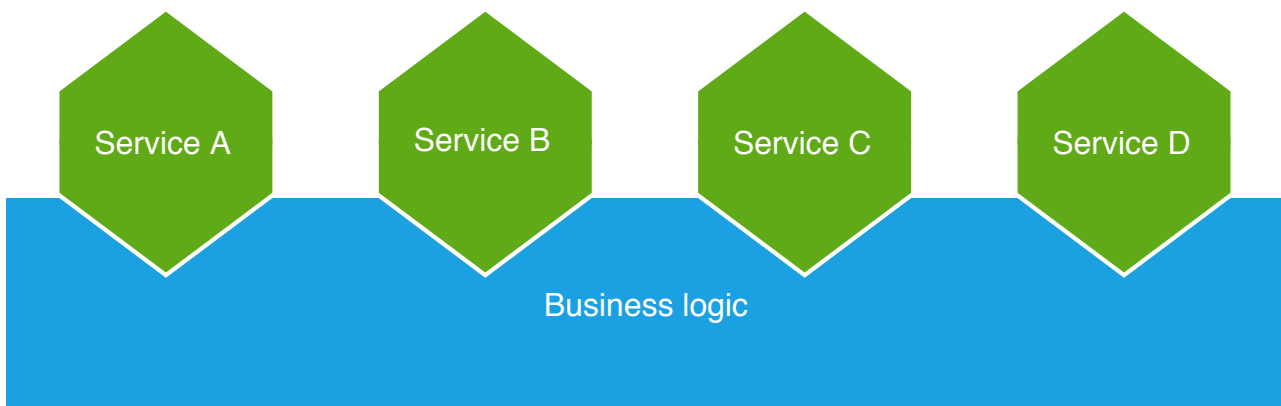


Figure 6.5: Micro services' relation to the business logic layer.

The benefit of decoupling the functionalities into micro services is that additional services can be coupled with the business layer, and altering the services, rather quickly, speeding up the development process, while maintaining testability and maintainability.

The micro services that are implemented in the system are:

- CreateUser
- EditUser
- DeleteUser
- ChangePassword
- CreateDonation
- EditDonation
- DeleteDonation
- CreateFood
- DeleteFood
- ReserveDonation
- DeleteReservation
- Chat
- FilteredSearch

From the above mentioned services, two examples will be given to provide a more in-depth explanation in code-snippet 6.5 and code-snippet 6.6 on the next page

```

1 def create(self, validated_data):
2     food_data = validated_data.pop('foods')
3     donation = Donation.objects.create(user_id=validated_data.pop("user_id"),
4     ↪ **validated_data)
5     for foods_data in food_data:
6         Food.objects.create(donation=donation, **foods_data)
7     return donation

```

Code-snippet 6.5: The add donation function.

In code-snippet 6.5 on page 55, the function to create a new donation is shown. this function overrides a default function of creating records in the database, which enables the possibility of having multiple food instances in a donation. Here, the function takes a dictionary parameter called *validated_data* that contains all the information that is to be saved in the database. First, all the food items are removed from the dictionary, and put into a new dictionary called *food_data*. Then, a donation is created with the user's id, and the remaining items in *validated_data*. Finally, all the food items are iteratively made into objects, containing the newly created donation's id, such that they belong to the specific donation. When all this is done, it returns the donation.

```

1  def update(self, instance, validated_data):
2      donation = Donation.objects.get(pk=instance.id)
3
4      donation.name = validated_data.get('name', instance.name)
5      donation.user_id = validated_data.get('user_id', instance.user_id)
6      donation.creation_date = validated_data.get('creation_date', instance.creation_date)
7      donation.deadline_date = validated_data.get('deadline_date', instance.deadline_date)
8      donation.pick_up_date = validated_data.get('pick_up_date', instance.pick_up_date)
9      donation.pick_up_address = validated_data.get('pick_up_address', instance.pick_up_address)
10     donation.pick_up_city = validated_data.get('pick_up_city', instance.pick_up_city)
11     donation.pick_up_zipcode = validated_data.get('pick_up_zipcode', instance.pick_up_zipcode)
12     donation.state = validated_data.get('state', instance.state)
13
14     donation.save()
15
16     food_data = validated_data.pop('foods')
17     for data in food_data:
18         if "id" not in data:
19             Food.objects.create(donation=donation, **data)
20
21     return instance

```

Code-snippet 6.6: The update donation function.

In code-snippet 6.6, the update function for donation is shown. Here, it starts of with finding the donation in the database by its primary key, such that the properties in the existing donation can be changed. Line 4 through 12 of code overrides the previous values in the donation instance with the new values from *validated_data*, which is then saved in the database. When saved, it iterated through all the new food instances that has not yet been given an id, and creates instances of them, and adding them to the record.

6.1.4 Django sessions

The Django framework gives the possibility of enabling sessions, which is a way of storing and retrieving data in the user's cookies. This practice is commonly used on websites to avoid that users have to log in on every visit on the website. Sessions in Django works on per-vistor basis which means even if the visitor is not logged in, data will be stored and retrieved on the server-side and defined on the visitor-end by a cookie ID, however, it is also possible to merely store the data in the cookies instead with the session engine: 'django.contrib.sessions.backends.signed_cookies'.

By default sessions is handled by 'django.contrib.sessions.middleware.SessionMiddleware', where *middleware* is defined by Django as: "Middleware is a framework of hooks into Django's request/response processing. It's a light, low-level "plugin" system for globally altering Django's input or output." The data from the requests/responses in the views the middleware will be able to manipulate, e.g. a view asking if the user is authenticated, the middleware will validate this request and send response to the view. In this system almost every view controls whether the user is authenticated with *if request.user.is_authenticated:*, and if this statement returns false it will redirect the user to the landing page. The aforementioned statement is a request to the SessionMiddleware and will therefore be stored on the server with a cookie ID on the user-end, which allows a user to revisit the website and still be logged in. It is possible to set a session to expire after a set time, but is not utilized in this system. The pages that a user that is not logged in can see are:

- Landing page
- Register page
- Login page
- About us page
- Contact page

It is a website intended for only a certain group of users i.e. companies and organizations, which means the main functions of the website is locked for unauthenticated users.

In the views it is also possible to create a new session variables, which as previously mentioned stores data on the server and sets a cookie ID on the user-end. This is utilized in this system when food items is added on the *addDonation* page as seen in code-snippet 6.7, which is done to avoid food items being lost due to malfunctions on either the server-side or the user-side.

```

1
2 foodSession.append({'name':request.POST.get("food_name"),
3                   'amount':request.POST.get("amount"),
4                   'food_type':request.POST.get("food_type"),
5                   'amount_type':request.POST.get('amount_type'),
6                   'expiration_date': request.POST.get("expiration_date")})
7
8 request.session['food_session'] = foodSession

```

Code-snippet 6.7: Example of usage of a session variable in the system.

Code-snippet 6.7 show example data from the POST request is first appended to a list and then the current data in the session is overridden. If a user leaves the site and comes back to *addDonation* the food items added earlier would be reloaded in the view. When removing a food item from a donation, the item will then be removed from the session variable list, and if a donation is finalized the session variable will be completely removed.

6.2 Front-end

6.2.1 Views

In Django, view functions is Python functions, or classes, that takes a request and returns a web response, e.g. in the form of HyperText Markup Language (HTML) content, an error, or a redirect. The view takes data from the API and presents the data through a template (see section 6.2.2 on the following page). Code-snippet 6.8 shows the view function for editing a profile. The function renders the `edit_profile` HTML-template and an HTTP-request to update the users profile is made.

```
1 def edit(request):
2     assert isinstance(request,HttpRequest)
3     if request.user.is_authenticated:
4         if request.method == 'POST':
5             response = httpToApi("users",request.POST,"post","edit",str(request.user.id))
6
7             print(response.status_code)
8
9             if response.status_code == 200:
10                djangoMessage.success(request, "Profile edited!")
11            else:
12                djangoMessage.error(request, "Failed updating profile")
13            return redirect(profile)
14
15
16        return render(
17            request,
18            'app/edit_profile.html',
19            {
20                'title':'Edit profile'
21            })
22
23    else:
24        return redirect(home)
```

Code-snippet 6.8: Example of a view function.

In code-snippet 6.8 there is an if statement which checks whether there is a POST request made in the browser which then handles the response and updates feedback to the user.

In the multiple views, HTTP requests to the API are made, therefore a function that could handle all these were created:

```
1 def httpToApi(apiUrl,data,http, action, id):
```

Code-snippet 6.9: HTTP request to API.

An explanation of each parameter are given below:

- **apiUrl** - The table that is to be manipulated.
- **data** - If a post request is made the data will need to passed in this parameter as a Python dictionary.

- **http** - Here the request method is stated e.g. get.
- **action** - This parameter is used if the request is for a single record or the table itself.
- **id** - If the request is for a single record an id is required.

The **httpToApi** function has a execution time of approximately 0.19 seconds on each request. This means that too many **httpToApi** calls would severely slow the rendering of each page. However, some of the POST requests could be handled on a different thread in the system, which would mean that the user would be able to continue browsing the website. This was not implemented due to resource prioritization in the project.

The time it takes to render a HTML page in the browser varies from 30ms to 350ms on average, which depends on what view is called. This is because some views have more data to gather than other before rendering.

6.2.2 Templates

In the Django Framework, templates are used to generate HTML dynamically, by containing the static HTML, and with a built-in template engine, Django Template Language (DTL), to insert content. This is a convenient approach, as the server will render HTML documents server-side with the template engine, producing a final HTML document that can be sent to the client. In code-snippet 6.10, an example is shown of an iterative control structure from DTL within a template. Additionally, the engine also receives a hash table containing data, which can be accessed as `value = hash-table-name.key`.

```

1  {% for donation in donations %}
2      <tr>
3          <td>{{donation.id}}</td>
4          <td>{{donation.creation_date}}</td>
5          <td>{{donation.name}}</td>
6          <td>
7              {% for food in donation.foods %}
8                  {{food.food_type}}
9              {% endfor %}
10         </td>
11     </td>
12         <form method="post">
13             {% csrf_token %}
14             <input type="hidden" name="don_id" value="{{donation.id}}" />
15             <button name="moreInfo">More info</button>
16             <button name="edit">Edit</button>
17             <button name="delete">Delete</button>
18         </form>
19     </td>
20 </tr>
21 {% endfor %}

```

Code-snippet 6.10: Example of an iterative control structure from DTL within a template.

6.2.3 User interface design

The website's user interface is meant to be as intuitive and easy to use as possible, but must also be enjoyable to use. As a result, the website is designed in a very familiar format. This means that the user is presented with design elements which are common on most websites, and will therefore have an easy time navigating the website. One such familiar element is the top navigation bar which gives the user access to all the important pages within one click. Less important pages are also placed as intuitive as possible and in "quick to reach places". Irrelevant content will be avoided to make the design as clean as possible. The top navigation bar, for a logged in user, can be seen in figure 6.6.



Figure 6.6: The website navigation bar.

Add donation is used during insertion of data into the system, was made by splitting the process into multiple smaller steps. For example, when adding a new donation the user must first add the food to the donation, after which he can add information such as pickup place and dates. In figure 6.7 and figure 6.8 on the next page the two steps can be seen.

Add food

Food

Category Dairy ▾

Amount kg ▾

Expiration date

Not applicable

Add food

Item list

Item number	Name	Amount	Expiration date	Category	Actions
					Next

Figure 6.7: First step of adding a donation.

Basic info

Pickup address My address Other address

Pickup date to

Figure 6.8: Second step of adding a donation.

In order to make the website appealing for potential new users, the website will have a homepage explaining the concept of the website in an easily understandable way.

Buttons and clickable links will be clearly obvious and visible. This will also be done by using known designs for links, such as an underlined text and a button with a different color than the rest of the content.

Footer (as seen at figure 6.9 at the bottom of the page is a bar similar to the navigation bar, except that the footer bar only has a link to the about page, the year, and who made the website.



Figure 6.9: The footer bar.


A footer bar is useful when having less important links like the about page, because a large amount of information at the top could distract users from the more important pages.

Available donations is the page with all the donations that are currently available for reservation. Figure 6.10 on the next page shows how the available donations are presented, Figure 6.11 on the following page shows how the filtered search function looks like.

Donor	Pick up date	City	Categories	Info
Kvickly, Grindsted	2019-05-22	Grindsted	Fruit,	More info
Aldi Aalborg Vest	2019-05-21	Aalborg	Fruit, Dairy, Dairy, Dairy, Dairy, Dairy,	More info
Kvickly, Grindsted	2019-05-23	Grindsted	Dairy,	More info
Johnny's grønthandel	2019-05-22	Frederikshavn	Fruit, Fruit,	More info
Rena1000	2019-05-21	Aalborg Øst	Meat, Fruit,	More info

Figure 6.10: The available donations.

Figure 6.10 shows the available donations. When looking for a donation, some different information is given. Donor shows which company that has donated the food. The pick up date is the date where the donation should be picked up, this is either because of expiration date or when the donor has time. City tells which city that the donation should be picked up in. The categories shows what kinds of food that is in the donation. Info has more info buttons making it possible to get more information if a user is interested.

Search 

City:

Zip code:

[Search](#)

Figure 6.11: The filtered search.

The filtered search function shown in figure 6.11 makes it possible to sort the donations either by a city or a zip code. The small hourglass above the search fields, makes the search fields able to be hidden by appearing after it is clicked and vice versa.

My donations is the page where the user can see the donations that they have a relation to. The my donations page has three parts; outgoing donations, reserved donations, and completed donations.

Outgoing donations is where the donations created by the user shows up, and has the options to show more info, to edit the donation, to complete, and to delete the donation. On the right side

of 6.12, a state of the donations can be seen. The colored text makes it easier to differentiate whether or not a donation is open or reserved. When a donation is reserved, more info is going to show information about the user that has reserved the donation.

Outgoing donations					
ID	Date	Categories	Info	STATE	
2	2019-05-16	Dairy	More info Edit Complete Delete	OPEN	
3	2019-05-16	Fruit	More info Edit Complete Delete	RESERVED	

Figure 6.12: The outgoing donations for an user.

Reserved donations at figure 6.13 is where the donations reserved by another users are shown, and has the options to show more info, to reopen the donation, and to close the donation.

Reserved donations				
ID	Date	Donor	Info	
4	May 18, 2019	foodlineAS	More info Reopen Close	
6	May 20, 2019	foodlineAS	More info Reopen Close	

Figure 6.13: The donations that an user has reserved.

Completed donations at figure 6.14 is where the donations that the user has created and delivered to another user. The options here is to show more info and delete the donation.

Completed donations				
ID	Date	Donor	Categories	Info
8	2019-05-20	foodline A/S	Dairy Dairy Dairy Dairy	More info Delete

Figure 6.14: The completed donations.

Profile page is the page where all info about a user, can be seen. It also has the message inbox for when another user send a message through more info on a donation.

Email: foodline@foodline.dk
Company name: Foodline
Vat number: 123456
Phone number: 12345678
Address: Vestergade 1
City: Aalborg
Zip code: 9000
Description: Foodline

[Edit info](#)[Change password](#)

Figure 6.15: The user information on the profile page.

Figure 6.15 shows what information that a user has written about themselves and an edit info button, which makes the user able to change information if it's wrong or has changed. The option to change password is also available here.

Inbox

Date	Sender	Message	
May 21, 2019, 1:33 p.m.	johnnyg@johnny.dk	Hi, is it possible to pick the food up another day?	Reply

Figure 6.16: The message inbox on the profile page.

Figure 6.16 shows the message inbox, where all the messages that a user receives, can be seen. The email of the user who send the message can also be seen, together with the date and time it was send. To the right of the message is an option to reply.

6.2.4 Functionality

In this section, the interaction between the components, and how they communicate with each other when the client interacts with the system will be described. This is done to get a better overview of what each component does internally, and how the data travels throughout the system. First, the interaction between the user and the web application is shown in figure 6.17 on page 66, and how the web application communicates with the API, which then uses models to create instances of objects in the database through the Django framework. Then, in figure 6.18 on page 67, it shows a more in-depth interaction with the web application and its surroundings.

In figure 6.17 on the next page, the user starts off with sending a GET request for the add donations page to the web application, by entering its corresponding URL. The web application then processes the GET request by acquiring the users information from the API, and sends it back to the website. The website then awaits input, which is sent back to the web application through a POST request, which contains the information the user has inserted into the website.

When the web application receives the information, it is validated, to ensure that the relevant information has been given, and that it is of the right format. In case there is invalid information in the request, the web application responds with an appropriate error message, signaling what went wrong. In case that the information is valid, the web application repackages the information and sends it to the API through a POST request. The API then processes the data, and sends it to the models, which handle the database queries. The models then responds, which is then sent to the web application. The web application then validates if the instance has been created. If not, the web application responds with an error message, otherwise it continues and redirects the user to the My Donations page, and shows an appropriate success message.

In figure 6.18 on page 67, the user starts off with sending a GET request to the web application, which routes to the views. In views, the appropriate function for adding donations is called. Here, it sends a GET request to the API, to get the current user's account details. If the user does not exist, the views function returns an error message.

If the user does exist, it inserts the account information into the appropriate template, such that standard information as their address is automatically inserted, in case the user does not need to change the address for the donation pick-up. The template is then returned to the user, such that the user can insert any information for the donation.

When the user submits the donation, the view function receives it, and sends it to the API, which saves the new donation in the database, and sends a response back, whether it succeeded or failed. Then, if it failed, the user is notified that there occurred an error, and if it succeeded, the user is redirected to my donations.

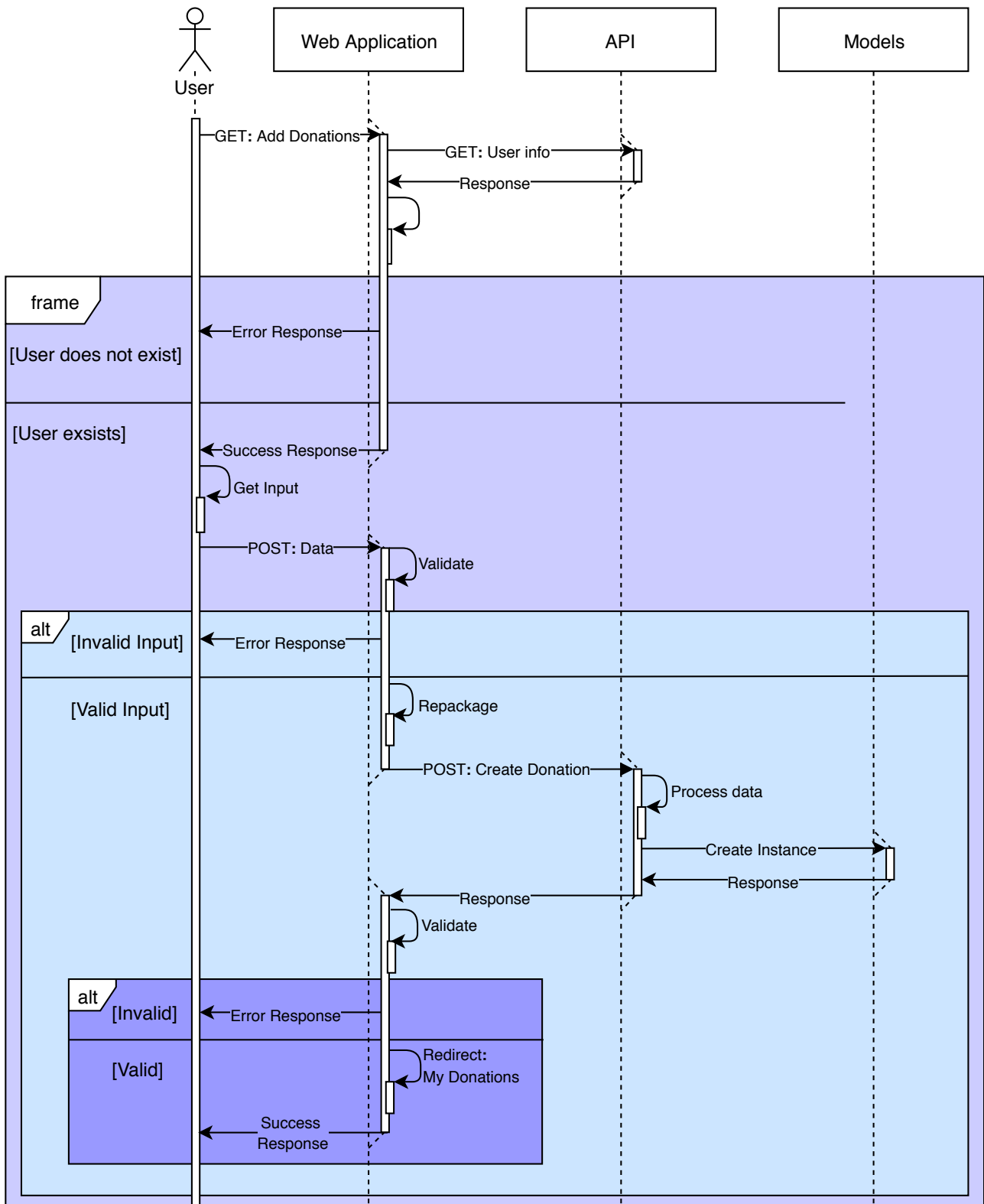


Figure 6.17: Abstract overview of the functionality of the system.

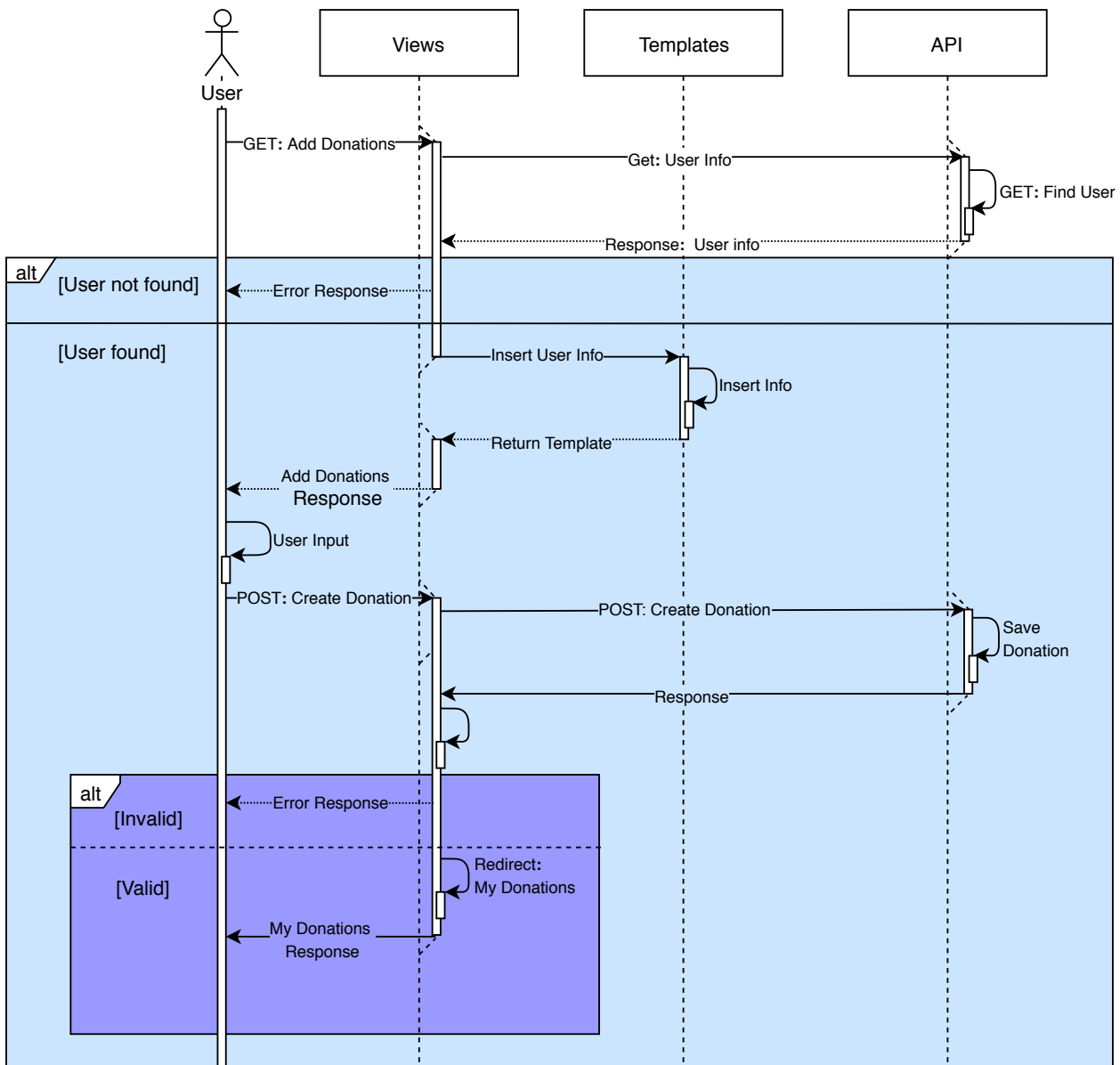


Figure 6.18: Specific overview of the functionality of the web application.

7 Test

Usability has always been the central point of human-computer interaction, as a system should be easy to use and easy to learn. The approach to the usability revolved around the human-centered systems design, where donors and receivers were the archetype personas, with two different activities and contexts, as described in section 3.2 on page 32.

In order to evaluate the usability of the system, specific scenarios are created, where a participant conduct activities in a context, where they use the appropriate technologies. One of the more important factors that needs to be addressed, are the complexity of the system, and potential flaws the system might have. [42]

To test the usability of the system thoroughly, the Systems Usability Scale (SUS) is used to evaluate the test results, which is done in order to give empirical evidence for the usability of the system. This will result in a score the usability of the system according to a percentile, which can be compared to a 7-point scale, to rate the system.

7.1 System Usability Scale

The method used in this test is The System Usability Scale (SUS). The U.S. Department of Health & Human Services [43] describes SUS as follows:

"The System Usability Scale provides a "quick and dirty", reliable tool for measuring the usability. It consists of a 10 item questionnaire with five response options for respondents; from Strongly agree to Strongly disagree. Originally created by John Brooke in 1986, it allows you to evaluate a wide variety of products and services, including hardware, software, mobile devices, websites, and applications." [43]

The 10 items are listed below. There are 5 positive toned items and 5 negative toned items:

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.

9. I felt very confident using the system.

10. I needed to learn a lot of things before I could get going with this system.

The items alternates its tone for every item, which is to prevent extreme response biases.

SUS will give a score from 0-100, and is calculated as follows:

- Question 1,3,5,7,9 = SUS score minus 1
- Question 2,4,6,8,10 = 5 minus SUS score

After this the scores are added together and multiplied with 2.5, to give the final SUS score on a scale from 0-100. Note that the score should not be interpreted as a percentage, but as a stand alone SUS score that can be compared to other relevant SUS tests. This could be tests made on similar products, earlier versions or the more general guidelines made by Bangor *et al.* [44], who looked at data from more than 1000 SUS-scores and created the scale seen in table 7.1.

Table 7.1: 7-Point Adjective Scale for SUS-scores [44].

SUS Score	Adjective Rating
90.9	Best Imaginable
85.5	Excellent
71.4	Good
50.9	OK
35.7	Poor
20.3	Awful
12.5	Worst Imaginable

The 7-Point Adjective scale can be used as an indicator of how well a system is regarding usability, seen in perspective of previously conducted SUS tests.

7.2 Method

The test was conducted at Aalborg University, by asking two groups to participate in the test, consisting of 4 and 5 participants. Both groups were informed that this was a usability test of a web page. Each participant were provided with guidelines, and conducted the test on their own computer. There were test observers present during the tests, in case technical problems occurred. The test observers were not allowed to give guidance to the participants regarding the execution of each task, as this would deteriorate the test results.

The guidelines were made to provide a context in which the system should be tested. This was done so the participants could place themselves in a intended use scenario for the system. There were no time limit for how much time a participant could use on a task. The test guide had

four tasks that the participants had to complete. These were made to cover all the functions of the system. The tasks looked like this:

1. Create a user and log in.
2. Create and post a donation containing two different categories of food.
3. Search for a donation in “Grindsted” and reserve a donation from that area.
4. Send a message to the donor of the donation you found in Grindsted.
5. Change password, log out and log in with your new password.

When a participant had completed the four tasks, they were asked to fill out a questionnaire, and if possible write down comments about the system. The questionnaire can be found in appendix B on page 91.

7.3 Results

The data collected from the SUS-questionnaire can be seen in table 7.2.

Table 7.2: Test Results

Test Subject	q1	q2	q3	q4	q5	q6	q7	q8	q9	q10	SUS Score
P1	3	2	4	2	5	1	4	2	4	3	75.0
P2	4	2	3	4	4	2	4	1	4	1	72.5
P3	4	1	4	5	4	4	4	2	3	5	55.0
P4	2	2	4	3	2	3	3	3	1	2	47.5
P5	3	1	5	3	5	1	5	1	4	2	85.0
P6	3	1	4	1	3	1	4	2	3	1	77.5
P7	3	1	5	1	4	2	5	1	5	1	90.0
P8	4	1	4	1	4	1	4	1	4	2	85.0
P9	2	1	5	1	5	1	5	1	5	1	92.5
Average											75.6

These values are used to create a boxplot, in order to identify potential outliers and to show the distribution of test-scores.

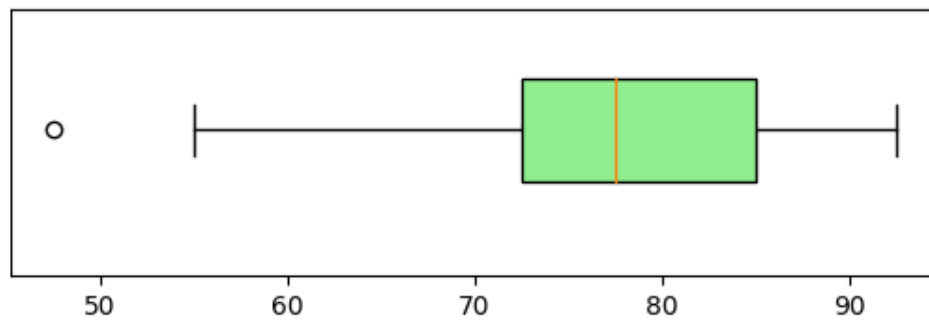


Figure 7.1: Boxplot over the data from the SUS test.

The boxplot shown in figure 7.1 reveals one outlier, with a score just below 50.

Table 7.3: Comments from users

User	Comments
P1	Red marking if the changed password does not meet the requirements. Would like to be able to see sent messages, to get an overview over the chosen donations. The "Available donations" button should be named "Search donations" instead. Would be more intuitive. It should say that you can chose whether you should type in city or zip code - it seems like you have to enter both, but you don't have too.
P2	Nice design - looks professional! Nice initiative.
P3	No comments.
P4	Missing feedback when changing password. Small search button, maybe this can be placed in extension of the "available donations" title. Short description of what you can do on the website, what you can do on the different pages. E.g. a small question mark, that you can click on and get info on what you can do here.
P5	Nicely done!
P6	It was not so intuitive to write to the donor whom I had reserved a donation with. I was redirected away from the page.
P7	No comments.
P8	No comments.
P9	No comments.

The results shows that the average SUS score is 75.6, which is just above the average score for web sites (68.2) according to Bangor *et al.* [44]. However, test subject P4's outlying result is noteworthy, as the result is significantly lower, compared to the other scores. P4 provided a comment, explaining that there was missing feedback when changing password, and that the search button was too small. The subject also wished to have some context, in which it was possible to see what the website could do, and what it was for. Some of this feedback

resonates with P1's comments, with additional feedback of: seeing your own sent messages, feedback on navigation naming on the website, and needed clarification when searching for donations. However, in contrast to P1's comment a SUS score of 75.0 were given, which might be ambiguous, as the score and comment does not seem to correlate. The remaining subjects only provided short comments, complementing the system. As mentioned in section 7.2 on page 69 the participants were not set under time constraints, and this did not become an issue during any of the tests.

8 Discussion

Stakeholders

The stakeholder analysis that was made was not thorough enough, as it did not explicitly outline what kind of stakeholders that was needed to be contacted. In order to get a better picture of what kind of possible features a system would need. Several wholesalers were contacted through email, and a few of them agreed to a phone or video meeting, where they loosely explained their current procedures regarding leftover food. As the deadline for the project was presented to the contacted wholesalers, they quickly lost interest in allocating their time and resources needed to provide the data needed. If more extensive research had been conducted with the relevant stakeholders, it could have increased the probability of deciding and prioritizing requirements for a system, which could have helped yield a more complete solution.

The interviews from Brazil was briefly explained in section 2.4 on page 28, and the key takeaways from each interviews were found, which assisted in setting the requirements in this project. As they ended up being the foundation of the MoSCoW analysis, it could have been wiser to have composed a group, consisting of the interviewees, and have them evaluate and outline what key takeaways should be used when defining the system. As Brazil was included as a case study there should have been gathered more data from that context. This could have been done by creating a guideline for how to find relevant stakeholders, and an interview guide containing the questions that were expected to be answered. This would hopefully provide relevant and comparable data, such that the two cases could have been used when defining requirements.

Development of the system

In section 3.3 on page 34, the requirements of the system were presented in the MoSCoW analysis, ranking the requirements from "Must have" to "Won't have". In the "Must have" requirements, compliance with GDPR was not fulfilled, as the system does not ask for consent to use the user's data, and it has not been disclaimed what the data is/will be used for, as it was not deemed as a requirement to test the system. This would be a violation of the GDPR if released, and must be fulfilled before a potential release. To fulfill this requirement, a terms and conditions document could be released that the users would have to agree on, before registering an account on the system. Furthermore, all cookies that are used, must be agreed to as well, in order to comply with GDPR. Another "must have" that was not fulfilled was administration of registrations, which had to be implemented to prevent unsought people from creating accounts on the system. This was not implemented, as it seemed to be the wrong approach, and there might be better alternatives for securing the system. Discussed alternatives include an invite system with referral links, checking VAT numbers in the VAT registry for authenticity, or create a rating system, where users can rate each other, to filter the authentic users from the

unauthentic. Lastly, the system does not support multiple languages, as the product was not tested in Brazil. This must be done when further developing the system, such that it can be tested in Brazil, and possibly be released in Brazil.

In the context of the system, there is no difference between donors and receivers. This was a choice that was made, such that the system did not need up to 3 types of users (donor, receiver, and a user type that could do both, e.g. food bank). This choice meant that all users were able to both receive and donate, as it was found to be less complex to develop the system. However, it was speculated that the activities each user-type would perform in the system would differ, as they would still maintain their respective roles, when interacting with the system, e.g. a donor would not reserve food. Moreover, it was not investigated whether three different types of user would enhance the usability of the end-user. This could be examined with potential users of the system.

The system was developed without the feature of automatic log-in on register i.e. a user had to log-in after registering. In the test result it was for one participant found tiresome and annoying to not have this feature of automatic login. This was designed by intent because an e-mail validation was desired before the user was created to avoid possible botting. However, this feature was not developed due to prioritization. It was therefore not examined whether this would hinder the user experience further. Furthermore, it was neither examined if it would be beneficial for the user experience if an automatic log in was implemented.

Additionally, there is no "stay logged in" feature that can be toggled when logging in to the system, as there currently is no limitation on the session cookie, which means that users actively must log off, to stop their session in the system. This is not the best approach, and the feature should be implemented in future versions of the system, to avoid unintended people from accessing other peoples accounts by gaining access to their device.

The design of the system architecture created the possibility of supporting multiple UI's, but as there has only been developed a Web UI, this feature is not used to it's full extent. But it does open up for many possibilities for further development. Separating the services the system provides into separate micro services could have been implemented in a better way.

Additionally, the micro services do not correspond with the events in table 4.1 on page 38. Donations currently does not expire, even though they do have an expiration date. This is a problem because a donation can be claimed even though some or all of the food in a donation has expired. A way to implement a solution is to remove the donations or specific food item when they reach their expiration date, and then completely delete the existence of the donation or the food. Moreover, a donation could also instead be archived instead of getting deleted, this could be found appealing to some organization to get a history of their donations.

Reservations do not have a reject reservation feature. Implementing this feature would be desirable, as some organizations might want the option of deciding who receive their donations.

The chat function does currently not work as intended, as it resembles a messaging system

more than a chat, and a user can currently not see their own sent messages. The reason for not further developing a full working chat function is due to the complexity of the task. If a complete solution were to be developed a chat function would be a high priority.

The current UI is not compatible with smaller screen sizes, such as smartphones, as the web interface does not scale correctly. This will require the CSS to be modified or potentially other front-end solutions could be examined, such that it can handle the different types of devices.

Protection of Personal Data

As mentioned before, the system does not comply with GDPR. One of the reasons this happened was that Django handled all authentication in the system, making the need for focus on security lesser vital than making the system testable. However, there is no restrictions for passwords when creating a user, so users are able to create passwords with no constraints, but when changing password, there are several restrictions. This became prevalent during the usability test, as a test subject found it difficult to reset the password, as they simply used a 1 character password to begin with. The same restrictions must be applied to the passwords that enter the system, both to make sure that the users have safe passwords, and to avoid any further confusion. This would enhance the security of a user's personal data, which would be beneficial. It also needs to be possible to reset passwords, in case a user forgets it or loses access to the account. This has not yet been fully developed, and has therefore not been included in the current version of the system. Compliance with both cookies and terms of service was not really considered while developing, as it was seen as one of the last features that should be implemented.

Test

As there were only performed one test, i.e. a usability test, the results gathered can only be compared to similar test results found by Bangor *et al.* [44]. It was assessed that the SUS methods was correct and reliable. There should have been performed tests on different versions of the system. This could have given the developers a continuous flow of feedback, helping to develop an even more user friendly system. The SUS scores would have been comparable, if the test was performed under similar conditions every time. Video recordings could have been made on each participant, and when analyzing the SUS scores, outliers could have been reviewed on video to specifically identify where they encountered problems when using the system.

As the test participants all were IT-students to some extend, one can speculate if their background made it easier or harder for them to use the system. In future tests, participants should be chosen based on criteria, made to ensure a wide variety of users, as one can expect the system to be used by.

The system has yet to undergo unit test, as the tests have not been created parallel with the system. This has been a mistake, as isolating the different modules, and testing them is a very good way to verify the reliability of the code. Additionally, the size and capacity of the

server the system will run on has to be determined through stress testing the system, to prevent the system from crashing, while on heavy load. The stress test will also provide additional information about certain weaknesses in the system, if the system overloads, while the server is not at full load.

9 Conclusion

Hunger is a prevalent issue on a worldwide scale, whereas developing countries suffer from famine and starvation, the developed countries suffer from different levels of food insecurity. This means that a system focusing on distributing food to socially vulnerable people, is something that could be beneficial to countless countries. However, it was speculated that an existing infrastructure of both technology and food would be needed in order for the proposed system to work as intended. This would mean that countries without the aforementioned infrastructure would therefore need different initiatives to combat hunger.

Other initiatives are already in place regarding distributing food waste, that otherwise would have been discarded, to people who are struggling to put food on the table on an every day basis. However, from different interviews it was found, that a common platform that establish communication between charity and donor was needed.

Based on the two chosen cases, Denmark and Brazil, the data collected was not sufficient, as it was discovered that the barriers to using a system like the one proposed were other than just functionality and user experience. It was found that donors only showed interest in donating food waste as long as the effort needed would be minimal.

It could be concluded that the food waste in especially developed countries were not utilized to its full potential, and it can therefore also be concluded that food waste could be a potential source to help combat hunger. Furthermore, it was found that reducing food waste would be beneficial to the environment in terms of greenhouse gas emission.

From the problem statement, it is affirmed that all the requirements from MoSCoW can be implemented, such that it facilitates the communication between donors and receivers through an online web-based platform. The platform has yet to implement some of the "must have" requirements, so whether the system simplifies food donation is currently inconclusive. The test conducted, found that the proposed solution had a good usability when tested on IT-students. However, the intended user-base for the system were not tested. This means that the usability tests were inconclusive in terms of deploying the system.

Bibliography

- [1] Åsa Stenmarck *et al.* *Estimates of European food waste levels*. 2016. ISBN: 978-91-88319-01-2. URL: <http://www.eu-fusions.org/phocadownload/Publications/Estimates%20of%20European%20food%20waste%20levels.pdf> (visited on 02/14/2019).
- [2] FAO *et al.* *The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition*. 2018. URL: <http://www.fao.org/3/I9553EN/i9553en.pdf> (visited on 02/11/2019).
- [3] World Hunger Education Service. *2018 World Hunger and Poverty Facts and Statistics*. 2018. URL: <https://www.worldhunger.org/world-hunger-and-poverty-facts-and-statistics/> (visited on 02/08/2019).
- [4] The Hunger Project. URL: <https://www.thp.org/knowledge-center/know-your-world-facts-about-hunger-poverty/> (visited on 02/11/2019).
- [5] Feeding America. *Understand Food Insecurity*. URL: <https://hungerandhealth.feedingamerica.org/understand-food-insecurity/> (visited on 03/06/2019).
- [6] W.O. Fawole *et al.* *Food Insecurity in Africa in Terms of Causes, Effects and Solutions: A Case Study of Nigeria*. Sept. 2015. URL: https://www.researchgate.net/publication/293814921_Food_Insecurity_in_Africa_in_Terms_of_Causes_Effects_and_Solutions_A_Case_Study_of_Nigeria (visited on 03/08/2019).
- [7] United Nations. *About the UN*. URL: <http://www.un.org/en/sections/about-un/overview/index.html> (visited on 02/15/2019).
- [8] United Nations. *UN Funds, Programmes, Specialized Agencies*. URL: <http://www.un.org/en/sections/about-un/funds-programmes-specialized-agencies-and-others/index.html> (visited on 02/15/2019).
- [9] United Nations. *UN SDG's*. URL: <https://sustainabledevelopment.un.org/sdgs> (visited on 02/08/2019).
- [10] United Nations. *UN sustainable development goals*. URL: <https://www.unilever.com/sustainable-living/our-strategy/un-sustainable-development-goals/> (visited on 03/29/2019).
- [11] United Nations. *UN SDG Goal 2*. URL: <https://www.un.org/sustainabledevelopment/hunger/#tab-6a70def4adf875248b6> (visited on 03/18/2019).
- [12] United Nations. *UN SDG Goal 12*. URL: <https://www.un.org/sustainabledevelopment/sustainable->

- consumption-production/#tab-36da8f1b226e289285d (visited on 03/18/2019).
- [13] World Food Programme. *WFP Overview*. URL: <https://www1.wfp.org/overview> (visited on 04/02/2019).
- [14] World Food Programme. *WFP Strategic Plan 2017-2021*. URL: https://docs.wfp.org/api/documents/WFP-0000019573/download/?_ga=2.72594836.603153486.1553084404-1450304530.1552914140 (visited on 03/20/2019).
- [15] United Nations. *UN SDG Indicators*. URL: https://unstats.un.org/sdgs/indicators/Global%20Indicator%20Framework%20after%20refinement_Eng.pdf (visited on 03/20/2019).
- [16] World Food Programme. *WFP Emergency Preparedness and Response*. URL: <https://www1.wfp.org/emergency-preparedness-and-response> (visited on 04/02/2019).
- [17] foodbanking.org. *Global Food Banking Network Annual Report 2018*. URL: <http://www.foodbanking.org/wp-content/uploads/2018/12/FINAL-GFN-2018-Annual-Report.pdf> (visited on 03/20/2019).
- [18] *Food bank wiki*. URL: https://en.wikipedia.org/wiki/Food_bank (visited on 02/13/2019).
- [19] Feeding America. *What is a food bank?* URL: <https://www.feedingamerica.org/our-work/food-bank-network> (visited on 02/11/2019).
- [20] Julian Teule *et al.* “Operation Zero Hunger: An Effort To Fight Hunger In Brazil”. In: (2018). URL: [https://projekter.aau.dk/projekter/da/studentthesis/operation-zero-hunger\(900c757a-c37f-4a0b-be52-874c701794ab\).html](https://projekter.aau.dk/projekter/da/studentthesis/operation-zero-hunger(900c757a-c37f-4a0b-be52-874c701794ab).html) (visited on 02/12/2019).
- [21] Landbrug og Fødevarer. *Madspild i Danmark*. Tech. rep. Sept. 2015. URL: <https://www.mm.dk/wp-content/uploads/2017/03/madspild-i-danmark.pdf>.
- [22] Jean C. Buzby *et al.* *The Estimated Amount, Value, and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States*. Tech. rep. United States Department of Agriculture, Feb. 2014.
- [23] European commission. *PREPARATORY STUDY ON FOOD WASTE ACROSS EU 27*. Tech. rep. Oct. 2010. DOI: 10.2779/85947.
- [24] Heller. M. *Waste Not, Want Not: Reducing Food Loss and Waste in North America through Life Cycle-Based Approaches*. Tech. rep. United Nations Environment Programme, 2019.
- [25] Anton Nahman *et al.* “Costs of food waste along the value chain: Evidence from South Africa”. In: *Waste Management* 33.11 (Dec. 2013), pp. 2493–2500. DOI: 10.1016/j.wasman.2013.07.012.

- [26] Stephen D. Porter *et al.* “A half-century of production-phase greenhouse gas emissions from food loss & waste in the global food supply chain”. In: *Science of the Total Environment* 571 (2016), pp. 721–729. DOI: 10.1016/j.scitotenv.2016.07.041.
- [27] Food Waste Reduction Alliance. *Analysis of U.S. food waste among food manufacturers, retailers and restaurants*. Tech. rep. Food Waste Reduction Alliance, 2016, pp. 20–26. URL: https://foodwastealliance.org/wp-content/uploads/2013/05/FWRA-Food-Waste-Survey-2016-Report_Final.pdf (visited on 03/01/2019).
- [28] *Stop Wasting Food Movement*. Mar. 2019. URL: <http://stopwastingfoodmovement.org/>.
- [29] *Culinary Misfits*. Mar. 2019. URL: <http://www.culinarymisfits.de/en/>.
- [30] *How governments around the world are encouraging food waste initiatives*. 2018. URL: <https://blog.winnowsolutions.com/how-governments-around-the-world-are-encouraging-food-waste-initiatives> (visited on 02/26/2019).
- [31] Folkekirkens Nødhjælp. *Om Wefood*. URL: <https://www.noedhjaelp.dk/vaer-med/wefood-danmarks-foerste-butikker-med-overskudsmad-og-varer/om-wefood> (visited on 02/26/2019).
- [32] Eleanor Beardsley. *French Food Waste Law Changing How Grocery Stores Approach Excess Food*. 2018. URL: <https://www.npr.org/sections/thesalt/2018/02/24/586579455/french-food-waste-law-changing-how-grocery-stores-approach-excess-food?t=1551172760541> (visited on 02/26/2019).
- [33] United States Environment Protection Agency. *Food Recovery Hierarchy*. Web. 2017.
- [34] *Brochure fødevarebanken*. URL: https://docs.wixstatic.com/ugd/bed531_d3c5bfb29b4d49fabd9be0b38ac9ce62.pdf (visited on 02/28/2019).
- [35] *Stop Spild Lokalt*. URL: <http://stopspildlokalt.dk/om-ssl/> (visited on 02/28/2019).
- [36] Project Management Institute Staff. *A guide to the project management body of knowledge (PMBOK? guide)*. 2008, p. 467. ISBN: 1-933890-51-7.
- [37] *EU Commission Notice*. URL: https://ec.europa.eu/food/sites/food/files/safety/docs/fw_eu-actions_food-donation_eu-guidelines_en.pdf (visited on 04/08/2019).
- [38] *EU Commission Notice*. URL: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32002R0178&from=EN> (visited on 04/08/2019).
- [39] E. F. Codd. “A Relational Model of Data for Large Shared Data Banks”. In: *Commun. ACM* 13.6 (June 1970), pp. 377–387. ISSN: 0001-0782. DOI: 10.1145/362384.362685. URL: <http://doi.acm.org/10.1145/362384.362685>.

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- [40] Google. *Secure your site with HTTPS*. URL: <https://support.google.com/webmasters/answer/6073543?hl=en> (visited on 05/23/2019).
- [41] Lets Encrypt. *About Lets Encrypt*. URL: <https://letsencrypt.org/about/> (visited on 05/23/2019).
- [42] David Benyon. *Designing Interactive Systems*. 2013, p. 604. ISBN: 9781447920113.
- [43] *SUS Info*. URL: <https://www.usability.gov/how-to-and-tools/methods/system-usability-scale.html> (visited on 05/21/2019).
- [44] Aaron Bangor *et al.* “Determining What Individual SUS Scores Mean: Adding an Adjective Rating Scale”. In: *Journal of Usability Studies* 4 (3 May 2009), pp. 114–123. URL: http://uxpajournal.org/wp-content/uploads/sites/8/pdf/JUS_Bangor_May2009.pdf (visited on 05/21/2019).

Appendices

A Report - Food distribution project in Brazil

The week from January 28th to February 1st the students of Aalborg University and the University of Brasilia went to the meetings with a lot of social institutions and big donors that were potencial testers for the platform. The meetings were helpful with the feedbacks to improve the platform and help with the usability as well. There were a few feedbacks that the meetings had in common: for example, that the communication between institutions and donors to arrange the food pickup would be facilitated by a chat, the description of the institutions should be more complete, because the bureaucracy of Brazil is much difference of the bureaucracy of Denmark. Considering the size of the Mesa Brasil, we discussed and thought that is better if we start the prototype using only their company. If they offer to us a field with about 10 charities, is enough to start the pilot test. And as the time goes, we can ask them to start testing the platform with more institutions. After doing this, we will expand the system for all the 200 charities institutions that Mesa Brasil helps. We thought about introducing a new member on the team: someone from IT, due to the knowledge about the platform and programming as well. So the person will have more technical knowledge and will be a good asset to help with our communication during the project. We will talk to João Mello about having another member on the team and we would also like to know if you agree with having an IT member on the project here in Brazil. Also João Mello talked to us about having his 15 students on the team as well and we we thought about some tasks so that they can help us with the project. We thought that they could help us getting the feedback you need for the platform, so they would get in touch with the donors and the institutions, collect the feedback and present it to you with charts or in the format that you prefer. Another option is giving them the responsibility to gather more donors and institutions to test the platform and also create a strategy of disclosure to make the website popular and enable big donors to start using the website as their main donating platform. Because we think our contact with Mesa Brasil is so important, we scheduled a meeting with them on monday, February 18th so that we can arrange the details about the pilot test. In this meeting we will discuss about the amount of institutions that they are going to test the pilot with and also if they are willing to test it with a greater amount of institutions.

Hugging the World - 29/01

In our first meeting, which was with hugging the world, on January 29th, they said that if the platform requires kind of legal document of registration, it would make the platform non accessible to all of the social institutions in Brazil, because there are a lot of social institutions (like them) that are mostly informal, that means that they don't have any kind of government registration. About the registration, it was suggested to put an * on all the boxes that necessarily have to be filled up so that the registration goes on easily. They also said that it would be

nice if we could implement some kind of an expiring date for the reservation, that way, if the institution reserves and don't really go there to pick up the food, the donation would become available again for the other charities. They said that they would like to receive some kind of notification, by email for example, if the reservation was completed. They think that is better if the software remains as a website instead of an app because they think that the platform, as a website, would be more accessible to all the institutions. About the reservation, they said that it would be better if the donations were divided as items, that way the charities could pick only what they need, instead of reserving it all. They also commented that it would be nice if we implement different kinds of donations, such as toys, clothes. As we already discussed this topic and we agreed that this feature could be implemented, but in the future, for now this is not the priority. After making a reservation of all the food that the institution needs, it was suggested that there should be some kind of warning for the institution to know that is their responsibility to get in touch with the donor in order to arrange a meeting to get the donation.

Notes:

- They asked if it was necessary to have a register number and have certain kinds of documents in order to register in the website (CNPJ)
- The translation for the part to pick between organisation or institution should be done carefully because of the terms Social Institution \neq Charity Institution (After the meeting with Mesa Brasil we realised that the access to food was a right in Brazil, so, providing food to the ones in need is social work, not charity)
- They thought it was interesting, on the registration part, to be indicated by * the boxes that they are obligated to fill in
- Another comment on the translation: the requirement of the food should be translated as reservation (suggestion)
- It would be nice to send an email to notify the institution that the donation has been confirmed
- There should be some kind of warning that the institution should get in touch with the organisation in order to schedule to pick the food up
- They thought that it would be interesting to remain a website, not an app so that everyone should have easy access to it
- The donations should be separated so that institutions could require only what is necessary for them
- This institution usually cooks for everyone and, on special dates, they gather food, clothes, toys and they bring the people in need there for a day with all the meals and also activities for the adults and the kids
- This is the institution that I've sent the photos from

Santo Anníbal - 30/01

The second institution that we visited was Santo Anníbal (the daycare for kids), the institution is 10 years old and they attend something around 300 kids during the day, but they also donate food for the families, so they help a lot of people. They had some doubts in terms of which institutions could join the program, what are the terms and conditions to be able to register in the site. They said that there are bigger institutions that receive larger donations, take what they need and pass the rest to the others, that way it would be nice if those institutions could register not only as receivers, but also as donors. They asked us if there will be some kind of prioritization to benefit specific institutions, they also suggested that it would be nice if could implement some kind of a rating system, that way the institutions would be more encouraged to donate. They also thought that the platform should require all the documentation from the social institutions so that the donor can evaluate the institutions that they are donating to. They had no difficulties with the registration part and thought that the site is very easy to use and very intuitive but they also highlighted the necessity to translate the site. It would be easier if we put some kind of chat in the site, that way both institutions could communicate in a easier way. It was also suggested once again that there should not be any specifications between donors and institutions on the registrations because many institutions can donate as well and also because there are distribution centers and they donate and receive. About the layout of the website, it was suggested that it would be more inviting and it should show people that everything is being done as volunteer work and there is no money involved.

Notes:

- In this meeting it was debated the criteria for the registration of the institutions because many institutions do not even have a registration number (CNPJ) and other institutions already receive help from the government
- Is there any kind of prioritization between the institutions when they will require a donation?
- Many institutions rely only on donations from people and do not receive anything from the government, so that should be prioritized
- It is important that the registration on the website doesn't specify the registration between donors and institutions in order to allow people to receive and donate
- Is there going to be any kind of prioritization so that the most in need can be attended faster?
- This institution, only at lunch, uses 10 packages of basic food in order to feed the 300 children that they take care of
- They use 5kg of beans everyday
- 24L of milk a day
- This institution helps 300 children

- The package containing basic food that they receive as a donation costs, approximately 40 reais
- On christmas or when they have more food, they donate to the families of the children as well to, approximately 58 families
- They don't receive enough donations, so they have to ask for more donations everyday
- The daycare is 10 years old
- The potential growth of the daycare is big and everything that they have build until today was because of donations
- During the test there wasn't many suggestions of improvements on the log in, log out, registration.
- There was a suggestion about the layout of the website in order to be more inviting for visitors, institutions and big donors
- There were no difficulties whatsoever registering on the website, logging in and logging out
- If there were a easier way to communicate with the donors would be better
- She said that the access to the website was very practical, very intuitive. There weren't many difficulties, the only problem was the language barrier because the website was in english. Other than that, she loved it
- She also thought it was interesting that donors can also edit their donations and add whatever they want
- She suggested the possibility of registering other donations than food (clothes, toys)
- Also it would be easier to log in as a donor and as an institution
- If there was a way no notify the institutions that their donation has been accepted or declined would make the communication easier
- It was suggested to be a message or a way that institutions know that is their responsibility to contact the donors, as said above, she thought it would be nice to have a chat
- She said that she loved the idea of the website, she really thinks it will be able to help a lot of institutions in need

R2 Productions - 31/01

In the meeting with R2 productions, Daniel told us that all the food they get, they send to Mesa Brasil so they distribute to the social institutions. Daniel gave us a very nice point of view telling us that our project has a very good intention, but is not the final solution do end the lack of food to some families, but it helps in a short term situation. He said that we need to implement some kind of a location service, that way the pick up part would be more efficient (maybe use google maps or something like this). Daniel also graduated in Industrial engineering,

with his knowledge, he told us that we have a subject called Operational Research, this will help us a lot in terms of dividing and distributing the food to the charities. He also said that we need to make the site interface more inviting, visually speaking, that way will be more attractive to the stakeholders (maybe we could use Riborn's interface as a inspiration).

Notes:

- Mesa Brasil
- R2 productions allows people to pay half the price of event tickets if they donate 1kg of non perishable food
- Mesa Brasil picks all the food that they collected and than the food is donated to institutions in need
- When they collect smaller quantities of food, the charities pick it up, but, because they are organising these big events, most of the donations are made to Mesa Brasil
- Partnership with Mesa Brasil
- Schedule meeting with them in order for them to test (we have already gone to the meeting at Mesa Brasil)
- Distribution center in order for the social institutions to get in touch with them
- Talk to Mesa Brasil because they are already a distribution center and it would be really nice
- They suggested to get different donations, money, food, toys, clothes
- How can we really solve the problems in Brasil? (thinking about future impact, the bigger picture)
- Go to the root of the problem
- So how can we help institutions in order for them to not need food donations anymore
- Layers regarding the amount of food donated and the magnitude of the charities
- Incorporate google maps as well in order for the charities to see which ones are the closest
- Layout of the website similar to Ribon (<https://home.ribon.io>)
- How to make this more attractive to donors?

Mesa Brasil - 01/02 The last institution that we visited was Mesa Brasil, there we learned an interesting mindset, they consider food a human right, so they don't call themselves as a charity institution, the best name is a social institution. They got some markets as stakeholders, but they only keep the business running only with donations, they have the support from the government on keeping the structure and also the workers available there. They are one example of a institution that can fit such as a donor and a food provider. Because of the amount of social

institutions that they are in touch with and also the frequency of donations that happens there, we thought that it would be interesting to get their help with the testing of the pilot because the platform has a great potential and it would be really important to be in touch with such an important stakeholder as Mesa Brasil to help us with the disclosure of it and also with how to make it even better and more inviting to all the brazilians stakeholders. We see that Brazil has a greater amount of stakeholders than Denmark and also the donations and relations between donors and institutions are different from Denmark. Because of that, we should learn from big donors and adapt the best way so that the platform becomes known in the whole country and makes an even greater impact here.

Notes:

- Food is a right, so they don't say charity! So it would be better to call the institutions social institutions
- 15 national program SESC
- Partnership with the supermarkets (donors) also farms
- The events just like R2 productions are a great way for them to collect food
- There are many institutions that pick food up from Mesa Brasil
- The institutions are the ones that pick the food up
- All the kinds of institutions contact them
- How does the distribution works? They select what is ready for eating, everything that don't follow this criteria, they don't take it
- They measure the attending number of every institution in order to donate the proportional amount for each institution
- Also, they prioritize the institutions that attend a bigger number of people in need
- Every 15 days the institutions come to Mesa Brasil in order to get their donations
- The donations are not guaranteed, there is a possibility that the institution gets there and there is not enough food for them
- Many institutions come weekly
- They schedule the visits, it's 20 institutions a day max
- When they make a donation, if they have a package, they donate the whole package, but they don't divide it. They donate the package the way that it came from the donor
- The usual food that they donate are the perishable ones: vegetables, leaves, fruits. The non perishable food comes from donos like R2 productions, it's not regular, only when they organize big events

- Rice, beans, sugar, cocoa
- The donations are based on the amount of people that the institutions attends
- When there are the events, the dry food is majority, so they are able to calculate the right amount for each institution
- They also visit the institution to teach them how to avoid food waste, how to cook the food, social work as well
- They have been doing the logistics for the institutions for 15 years, they donate for 217 institutions already
- They see the possibility to get more donors in order to gather more food. They think it's interesting to use the software as institution
- The software is a possibility to reach big companies in order for them to donate even more and gather even more donors
- They are always searching for donors in order to be able to donate for these 217 institutions
- The institutions that they donate to are divided by 4 groups:
 - 1. institutions that don't have structure
 - 2,3. institutions that get help from the government
 - 4. institutions that help families (bigger numbers) are called by them
- 1213 each week
- Each family has 4 people, so, that donation would be for 4K people
- They go to places to pick the food
- They see themselves as the bridge between donors and institutions
- 60 donors
- The institutions look for them, they give them the registrations and they say yes or no
- Maybe it would be interesting to as for the documentation on the site in order to (the donors) see if they agree to donate or not
- It would be really nice to have registered informations about the institutions (these aspects could be seen by the donor and it would help them to know who they are donating to):
- How many people do they have?
- Do they already receive help from the government?
- Are they registered? (CNPJ)

- What kind of institution it is? (day care? cook food for people in general? Distribution Center?)
- Do they have proper structure?
- When they have seasonal food that have short expiration date, they teach the institution how to cook it many ways so that the food doesn't get wasted
- They monitor regularly the documentation of these institutions and there are penalties for not presenting the proper documents
- They can suspend the institutions if they don't bring the document that they require
- There are monthly meetings between them and the institutions
- Close relation with the institutions
- Every 2 years they do an international seminary in order to debate starvation
- There are 3 interns from UnB working there
- They require a visitation before donating
- Maybe a way to verify the documentation at the website and also a platform (e-mail) to schedule the meetings
- The food arrives at noon and then the institutions pick everything in the afternoon
- They tend to try to donate fresh food as possible
- Is there going to be any criteria to prioritize the line for the food?
- They do every year an action plan for every institution for each institution
- Also a checklist to monitor the main actions
- Institutions for the federal district
- 70% of institutions that attends children

B SUS test

The following test is of a market platform. The following scenarios are made to test the general functions of the system. After the five scenarios has been completed, you will have to fill out a 10 question questionnaire. If you get stuck with any of the tasks, let us know, and we will provide support.

B.A Test scenarios

- Create a user
- Create and post a donation
- Search for and reserve a donation
- Change password

B.B Evaluating test results

To evaluate the results, the test subjects are asked to fill out the questionnaire seen in figure B.1 on the following page.

Participant ID: _____ Site: _____ Date: ___/___/___

System Usability Scale

Instructions: For each of the following statements, mark one box that best describes your reactions to the website *today*.

		Strongly Disagree				Strongly Agree
1.	I think that I would like to use this website frequently.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.	I found this website unnecessarily complex.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.	I thought this website was easy to use.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.	I think that I would need assistance to be able to use this website.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.	I found the various functions in this website were well integrated.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.	I thought there was too much inconsistency in this website.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.	I would imagine that most people would learn to use this website very quickly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8.	I found this website very cumbersome/awkward to use.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.	I felt very confident using this website.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10.	I needed to learn a lot of things before I could get going with this website.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please provide any comments about this website:

This questionnaire is based on the System Usability Scale (SUS), which was developed by John Brooke while working at Digital Equipment Corporation. © Digital Equipment Corporation, 1986.

Figure B.1: The questionnaire handed out to be answered when doing the SUS test.