HOW CAN THE FOOD WASTE BE REDUCED?

Bachelor thesis  BFA 2016
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INTRODUCTION

WHAT IS FOOD WASTE?

How can we reduce food waste in the households and increase the awareness of the problem?

What is food waste?
Food that got thrown away but if treated differently could have be eaten.

ABSTRACT

70% of the fresh water and 40% of the earth surface is used for agriculture purposes. Today we throw away nearly every 3rd grocery bag we buy. By doing this we waste a lot of the worlds resources. Only in Sweden we spoil 1.2 billion tons of food every year. 700 000 tons of this is from the households. The biggest source to the waste is single households and families with children, this became the target group for this project. We have to change our behaviour to preserve the earth’s resources.

The research showed that the biggest reasons that we throw so much food is that we first of all buy to much food. We don’t have time to eat all the food we buy and it get therefore spoiled. This is a consequence from that we don’t see it as a problem. There is a lack of knowledge in how much we throw away and how to store food correctly. We bad at planing our meals and grocery shopping and we end up with to much food because of this.

This project investigates how we can reduce the food waste. The analysed problem areas was used as a starting point in the ideation. The project focus is during the storing of the food in the households and how to keep track on the food we have. The storing of the food can be divided in three parts, make food last longer, plan the meals and shopping and keep track on the food we have.

The final result is the smart food storage. It is a concept that helps the user to get a good overview of the food and to store it in an optimized way. It enables for planing of grocery shopping and helps you keep track on the food you have.
Collaboration partner:
This project is in collaboration with Electrolux that contributes with knowledge, research studies, tutoring and sponsoring.
Peter Andersson
Jérôme Esteve
Torbjörn Malm

Examiners:
Eva-Lena Bäckström
Per Shilen

Tutors:
Paco Lindoro
Johan Gustafsson

Thanks to:
Jennifer Timper-user
Klara Båth-SIK
Olof Björkqvist-MIUN
Hanna Nykänen-Electrolux

TIMEPLAN
For more detailed time plan, see attached file.

**Research**
- Collect facts
- Interviews
- Observations

**Analyse**
- Existing smart technology
- Existing products
- Summarize
- Function list
- Summarize research
- Personas
- Workshop

**Develop**
- Sketch
- Ideation
- Brainstorming
- Mock ups
- Workshop
- Sketch
- Mock ups
- User testing
- Evaluation

**Refine**
- Form development
- Sketch
- Evaluation
- Form development
- Interface
- Cad
- Model making

**Finalize**
- Cad
- Model making
- Presentation material
- Presentation
- Finalization
- Finalize report

Week 08: 22/2 - 16
Week 09: 22/4 - 16
Week 10: 22/2 - 16
Week 11: 22/4 - 16
Week 12: 22/2 - 16
Week 13: 22/4 - 16
Week 14: 22/2 - 16
Week 15: 22/4 - 16
Week 16: 22/2 - 16
BACKGROUND

Food Industry
Almost 40% of our planet’s ice-free surface and 70% of the fresh water is used for agriculture purposes. In 2050 it is estimated that our population is going to be more than 9 billion people. As our population grows and the demand on food and meat increases we will have to increase our food production with 50% to be able to feed everyone. There is a growing fear that while our population is growing our resources and food will not be enough for everyone.

Food Waste
Approximately 1.2 billion tons of food is being thrown away or spoiled annually in Sweden. That is the same as 3% of Sweden’s greenhouse gas emissions. The food waste is produced in the whole food chain. By production, grossists, suppliers, households and restaurants. 770,000 tons of the waste comes from the households. That means that every person throws away around 81 kg food per year. If you take all 1 country in consideration the waste, where the problems is the biggest, is between 95-115 kg per person and year. Some of the waste is not eatable for example banana peels but most of it is fully eatable food. Except from the waste that is thrown away there is 224,000 tons of waste in the sink as well.

Some countries waste billions tons of food while others don’t have enough food to feed everyone. Food waste contributes to a lot of negative things for the environment and drains our resources.

Why not Bio gas?
From a climate point of view it is 10 times more effective to use all the food we produce instead of making bio gas out of it. It is better to reduce the climate emission in the food industry than to take care of it afterwards. It takes energy to digesting food into gas, a general calculation is that you can get 10% energy back from the gas out of the amount of energy it takes to grow the food. This is why it is better to start approach the problem before it appears.

Food Waste

Households
In the household there is a lot of eatable food thrown away just because the expiration date has expired or are about to. A lot of people believe that if the expiration date on the milk expired the day before the milk has gone bad and simply pour it out in the sink without testing it. We don’t trust your senses anymore but blindly rely on the labels. We are also very bad at taking care of the leftovers and food that doesn’t look perfect, but still is good enough to make a pie out of for example. Instead we are letting the food stay in the fridge until it really is bad and uneatable.

One of the biggest problems with food waste is that you don’t know that you do it.

Planning
Bad planning and big packages are two big reason for the food waste in our homes. We shop on impulse and falls for cheap prices without thinking about what we really need and how much we need. Then the food will stay in the fridge until it gets spoiled and thrown away. The money we thought we saved by buying the big pack gets lost because we didn’t have time to eat it all.

Through better planing and awareness of what we are wasting we can reduce the food waste and the impact that it has on our environment and save our resources.
FOOD INFO
FACTS ABOUT FOOD

What do we throw away?
Most of the waste is vegetables (49%) and fruit (21%) but there is also a lot of waste from bread (21%) and dairy products (17%). Meat, fish and eggs is also a big part of the waste and they also have a big negative effect on the environment. There is a clear pattern that shows that perishables are the biggest part of the food waste. This is usually grocery that belongs in the fridge.

How can we make the food last?
To make grocery last longer we have to know how to store it. A lot of grocery are stored wrong and spoils faster that it have to. It is specially vegetables and fruit that are extra sensitive for temperature and environment change. There are a lot of different tips and trix to make your food last longer. For example is it good to keep cheese, ham and sausages in packaging or plastic bags to prevent them for drying out: An other good tip is to not wash fruits and vegetables before putting them in the fridge and to keep the original packaging because the packaging is often made for just the right conditions for that type of food. For example do salad bags contain a gas mix of CO2 and N2 to keep the freshness of the salad longer.

How do we store food?
In general the colder we have our fridge, the longer will the food last. As long as it is over freezing temperature. The recommendation from Naturvårdsverket is to keep the fridge 4°C. Because a fridge is not that exact this will lead to that it is 2-6°C. Some food is mose sensitive for cold temperatures than other, cucumer for example freezes easaly and should therefor not be in temperatures under 10 °C while meet and fish can be in temperatures around 0°C without freezing. Some food is good to store in cold temperatures but doesnt taste as good then It can be good to plan a bit ahead with this food and take it out of the fridge a few hours before the planned meal. See infographic to for more detailed temperature for each type of grocery.

Temperatures impact on food
The temperature recommended temperature in a refrigerator is between 8-4 °C depepdning on the manufacturer. Naturvårdsverket recomends not warmer that 4°C. The colder the refrigeratos is the better.
Bacteria, molds and yeasts don’t grow that fast in cold temperatures. By lower the temperatur in the fridge from 8°C to 4°C some groceries can even last twice the time it would have. The whole food chain impacts the foods shelf life. The whole chain is the longer will the food last. It is good to keep a even temperature. If the food gets cold and warm many time it will spoil faster. This is good to think about during for example shopping and during long breakfasts. If it is hot outside it is good to bring a cooling box while shopping to bring the groceries home in and to put the milk in the fridge fast and not let it stay outside in the heat for a long time.

What happens when the groceries go bad?

Food can go bad in different ways. Usually three ways are mentioned. Physical spoiling, chemical spoiling and microbiological spoiling. Physical spoiling is easy to see. It could be when the chips gets in to small pieces or freeze and dry damages on the food for example dry bread. This as not bad for us but can taste a bit different. The chemical spoiling could for example be when the milk rancid. Fat and carbons breaks down and create this reaction. It is usually possible to smell and taste chemical spoil when it happens. This process depends a lot on temperature, oxygen and light. Microbiological spoiling is the hardest to notice. It is bacteria that grows on the food. Some bacteria is safe and could even be good for us. But some are bad for us and could make us sick. The bacteria need water and energy (sugar, carbs) to grow. Usually it grown on ham, milk and jam. Some bacteria is like the chemical spoiling easy to smell and taste. We just need to trust our nose. Then there are bacteria that isn’t possible to smell. An example on this bacteria is Listeria. We only need a really small amount of this bacteria to get sick and that’s why we can’t notice it. Most of the bacteria die in fridge temperature. But a few can survive all the way down to -1°C.

INTERVIEW
FOOD WASTE

KLARA BÅTH
FOOD BIOLOGIST, WORKING WITH MICROBIOLOGICAL ORGANISMS.

Klara Båth is a food biologist at SP Food and Bioscience, she was asked questions about food safety, how to prevent food waste and technology on how to measure food.

Food and to measure if food is okay to eat or not is a complex subject. Every type of food goes bad in different ways shows it in different ways. Generally for all food there are three ways it can get spoiled. Physical spoiling, chemical spoiling and microbiological spoiling. Depending on the type of food it takes different time do start this process. For example can a milk last 8-10 day and a piece of ham 20-40 days in the fridge. Temperature, light and oxygen is big factors when it comes to how long the food is fresh.

According to Klara is it hard to measure bacteria in food in a simple and fast way. Because all food is different and acts in different way there is difficulties to find one solution for all types of food. In the lab, bacteria is grown until they have become so big that they can be seen through the microscope. It takes between 3- 4 days to do this. All micro-organisms creates gases and gas compositions that is measurable. It is this gas that is possible for humans to smell. Depending on the type of food and bacteria different gases and volatiles is created. The measurement has to be adapted to each type of food. There are sensors that can measure these types of gases, some are used in the packaging industry. For example sensors that measure Ph-value in fish or carbon-oxide in vegetable.

Klara’s tips on how to reduce the food waste is through better planning, have a colder climate (4°C) in the fridge, store the food in a optimal way and keep a good hygiene in the kitchen. By lower the temperature in the fridge from 8 to 4°C the food can sometimes last twice as long. She gives the example of ham that last up to 40 days instead of 20 that it says on the package.

“By lowering the temperature in the fridge from 8 to 4°C the food can last twice as long”
STUDIES
ELECTROLUX

Studies made by electrolux concludes that there are two types of people. One group so called “stufflers” and on called “sorters”. These two handles groceries in different ways. Sorters have a very organized way of storing their food by category, they always check what they have at home before grocery shopping and they have a very clear system in the refrigerator. This group are most likely to be female adults and pre nesters or emty nesters. Stufflers have a more flexible system and put food where there is room and don’t always check the fridge before grocery shopping. This group are most likely to be male adults, teenagers and families with children. This shows that families have a harder time to maintain the order in the fridge and because of that don’t have as good knowledge of what the fridge contains when grocery shopping. They also have less time to put on planning beforehand and needs to be more flexible in time.

TECHNOLOGY

Smart packaging
Smart packaging is the collective name of packaging that in different ways can measure if the food gone bad or not. The packaging uses technology and sensors that measures time, temperature and sometimes gases that comes from the food. There are different kinds of smart packaging, active, intelligent and interactive, these works in different ways. See attach file.

ATP measurer
A ATP measurer is a luminometer, a device that with the help of light can measure organic material and the bacteria on a surface. A tops is used to swipe the surface, then put in a pipe with a enzyme and place under the light measurer that after 10 seconds tells how much bacteria and dirt there are on the surface. The device measures all organic material and can there for not be used to measure bacteria in food.

TODAYS MARKET
WHAT DO WE HAVE TODAY?

Fridges
There are many different kinds of fridges today. Most of the fridges have already set places for different kinds of food where it is suppose to be the best. For example do almost every fridge have the vegetable boxes at the bottom and the butter and eggs in the top of the door. This places is not always correct and depends on how warm or cold the fridge is. Also it recuries that the user know and follows these guidelines.

There are also new smart fridges on the market now. For example the Samsung Family Hub. The fridge have a screen in the door that contains all kinds of information, the family schedule, shopping lists and music. The fridge also have a camera built in the door and takes a picture every time the door closes. This makes it possible to check what you have in the fridge when you are at the store with an app.

There are also many concepts that in different ways scans the food before or when you put it in the fridge.

Applications and services
In addition to the issue of storing food correctly there are many applications and services that helps you plan your food purchases before you go to the store. A lot of the applications can also give you tips on recipes and what to do with the food that are about to expire. An other way to make it even more simple for the costumer is the services that planes, buys and delivers the food to your door. The problem with this type of service is that no family is the same. Some gets to much food and some to less or food that you do not like. According to my surveys answers this is something that most people don’t use. Sometimes for the shopping list but mostly is the planning made in traditional way with pen and paper.

Campaigns
Many governments and institutes do campaigns with information about food waste. Why we need to spoil less food and tips and trix on what we can do to reduce it. There are a lot websites and applications that have this information but we need to actively go and look for them and know that we need to look for them. An example of this is the campaign “Släng inte maten” from Konsumentföreningen Stockholm. This website educates and lists tips on how we can behave to reduce the food waste in our homes.
Internet of Things (IoT)

Internet of Things (IoT) is a trend that has been going on for a while. You can explain it as The network of physical objects that enables objects to collect and exchange data. This means that we add sensors to products such as household products, vehicles, and clothes to make them acknowledge and communicate with their surroundings. This is used to create smart, attractive, and helpful environments. The industry is now trying to open this up to the mass, and to make it more interesting and accessible for the people. Everything leans towards this trend. To connect yourself and your products. This is visible in our smart homes and connected products.

Smart homes

A smart home is when the products in the home talk and communicate with each other. It could be the fridge, the speakers or the lamps and locking system. It is possible to control all of these products with the smart phone or tablet. But each product usually has its own system and application. There is no standard system of controlling. There are many different ways of connect the smart home. One of the first ways was with X10 system that connects via the electricity cords. Bluetooth and Wifi are examples that uses radio waves to connects. There are also systems that uses a mix between them two so called Dual mesh network. Insteon is an example of a system that uses that technology.

Connect dumb products

To make a dumb product smart is when a product without network connection is connected. There is add-on products that smartens up the old “dumb” ones. Examples on this kind of products is Bosh perfect cook and LG SmartThingQ Sensor.

Mindful Design

Mindful design strives to create active choices and awareness of social and durable choices. It is meant to make us conscious of our everyday decisions and help us make better choices. By knowing the consequence this will lead to behaviour and attitude change and mindfulness. One example on mindful design is a concept IKEA did in collaboration with IDEO and Lund University. They made a sink where you always have to choose so save grey water and water the plants or wash it away because it is to dirty to use.
USER AND TARGET GROUP TO UNDERSTAND THE USER

User
Food waste is a big debate in Sweden right now. We see on the news that it is a big problem for the society and environment. This is why 8 of 10 thinks that food waste is a big problem in the society. But we don’t see and know how much we throw away ourselves. We don’t make the connection between our own behaviour and the problem in society. This is why 9 of 10 don’t think it is a personal problem. Statistics from Naturvårdsverket shows that the largest source of waste in the society is single households and families with children. This became the focus for further research and target groups in the project.

Survey
To get a better view on the target group, a survey was sent out. It was sent to 50% single households and 50% families with children. The survey contained questions about shopping habits and eating habits. The survey shows that 68% buys big packs or campaign special offers. There are hardly anyone that uses applications that help with the planning, only 14% uses it sometimes.

Flow chart
Two flow charts was made, one over the target groups journey from grocery shopping to cooking and cleaning of the table and one over the foods journey from store to fridge to table or waste bin. This was a way to map out the problem areas and to see where a solution can do the best positive impact. From these flow chart you can see that one problem area is that we can’t remember what groceries we have at home when we are at the store and that we are wasteful in the handling of the food when cleaning up.

Survey responses:
- 68% buy big packs or campaign special offers
- 14% use applications that help with planning
- 2% do not use applications
- 19% do not use applications

Flow chart responses:
- 16% half-nega
- 59% not so negative
- 25% Nega
- 25% Nega

Vilken typ av mat slängs det mest av i ditt hushåll?
- Grönsaker och frukt: 36%
- Resten som inte blivit uppspåtna: 32%
- Mejeriprodukter: 6%
- Övrigt: 16%

Använder någon i hushållet planerings-, handlingsapplikationer som hjälp vid matinköp?
- Nej: 86%
- Ibland: 14%

Hur noga är du/ni med att följa datum-märkning på mat?
- Nega: 16%
- Halfnega: 59%
- Noga: 25%

“Går på lukt och smak”
- Grönsaker och frukt: 36%
- Resten som inte blivit uppspåtna: 32%
- Mejeriprodukter: 6%
- Övrigt: 16%

Vad är största anledningen till att mat slängs i hushållet?
- Grönsaker och frukt: 64%
- Mindre än en portion: 8%
- Köper för mycket: 12%
- Övrigt: 8%
**FLOW CHART**
USER AND FOOD CHAIN FROM STORE TO HOME

1. Shopping.
   - Check the fridge
   - Plan purchase
   - Shop from list
   - Unpack fridge
   - Decide at the store
     - Do not know what they have at home. Buys twice.
   - Impulse shop
     - Buys wrong and too much.
   - Grocery shopping
     - Organized
       - Pack the fridge
         - Where there are room
           - Reduces the accessibility and visibility.

2. Storing.
   - Throw away if necessary
     - Old leftovers, milk, vegetables, etc...
   - Save leftovers
   - Throw away leftovers
     - Less than one portion.

3. Cooking.
   - Eat
     - Cook
1. Groceries go from store to home, fridge.

2. Groceries gets stored in fridge.

3a. Groceries go from fridge to bin.

3b. Groceries go from fridge to bin.

4a. Groceries go from table to fridge.

4b. Groceries go from table to bin.
Persona, Scenario

To get a further understanding on the users two personas and scenarios was created, based on the survey answers and studies made by Electrolux. One for single households and one for families with children. Later this became the starting point for the ideation phase.

Chosen target group

The project will focus on families with children. This target group is the one most likely to have the motivation, interest and economy to invest in a product that helps reduce the food waste. This is a target group that don’t have a lot of extra time. The parents take their children to school, to football practise, to tennis, prepare dinner and after dinner there are another hockey practise they need to attend. They have barely time for themselves and how could they then have time to plan the shopping and cooking for a whole week? And how can they keep track on what food they have at home when they also need to keep track on all the practises, what fika they need to bring to Sagas school on Friday and Grandmothers birthday on Sunday?

KLARA

STUDENT

Ensamhåll:
Klara, 21
Bott hemifrån 2 år
Har en liten kylfrys i studentkorridor
Bor på gångavstånd till affären och handlar 2-3 ggr i veckan.
Äter ofta resterna till lunch som matlåda och slänger mest grönsaker och mjölk som blivit dåligt.
Planerar för de mesta sin handling.
Äter ofta med sina vänner vilket gör att maten som var planerad ibland blir dålig.

KLARA

Ensamhåll:
Klara, 21
Bott hemifrån 2 år
Har en liten kylfrys i studentkorridor
Bor på gångavstånd till affären och handlar 2-3 ggr i veckan.
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Planerar för de mesta sin handling.
Äter ofta med sina vänner vilket gör att maten som var planerad ibland blir dålig.

HENDRIKSSONS

Barnfamilj:
2 vuxna och 3 barn, Eva och Peter, Kalle, 10, Erik, 7, Saga, 5
Bor i villa en liten bit ifrån en affär. Tar bilen för att handla.
Familjen har en hel kyl och hel frys.
Familjen handlar 1-2 ggr i veckan och försöker planera i förväg men hinner inte alltid.
Det som slängs mest i hushållet är gamla rester och grönsaker som har hunnit bli dåliga.
Familjen liv kan vara rätt stressigt när barn ska lämnas och hämtar på träningar och scoutmöten.
Det är svårt att hinna med att planera varenda måltid.
Precis köpt hus och lägger all ledig tid på renovering och trädgård.
Öppen för ny teknik och intresserade av trädgårdsarbete och skidåkning.
Äter ofta till fjällen över loven och ibland på helgerna.


Extra pris
3 för 2

Klara
Klara need a break from studying. She decides to go grocery shopping. First she checks the fridge to see what she have to buy. Then she takes her bike to ICA because it is pretty close. At the store she grabs a basket. When she comes to the milk there is a big sign that says take two for one so she takes two milk packages and thinks “I always need a lot of milk.”

When she gets home and are about to put in the groceries she first need to clean out a old milk and some old and nasty spinach. Today there is pasta and pesto on the menu. After dinner Klara throw the left over in the bin. She took to much food and couldn’t eat it all. She puts the rest of the leftovers in the fridge for lunch tomorrow.
SCENARIO
NR. 2
FAMILIES WITH CHILDREN

Jens hämtar barnen från skolan.

Jens tar bilen och köer mot ica, han ringer sin fru Eva från bilen.

Jens handlar med kundvagn för att få plats med all mat.

Barnen vill ha olika varor och tjatar på Jens.

Jens köper extra mjölk för det går alltid åt mängder av mjölk hemma.

Jens tar bilen och kör mot ica, han ringer sin fru Eva från bilen.

Jens tar bilen och köer mot ica, han ringer sin fru Eva från bilen.

Fam Henriksson

Jens picks up the kids from school. He calls his wife from the car to check if they need to buy something. At the store Jens takes a carriage to fit all the food and kids. The kids wants ice cream and nags on Jens until they get it. There is a big sign that says take three milk for the price of two. Jens takes three and thinks that they always use a lot of milk.

At home Jens unpack all the groceries, he throws away some food that gone bad and realise that they already had milk. Todays dinner is pasta and meatballs. After dinner Eva has to throw away the last of Eriks food because he didn’t eat it all. She also throws away the two last meatballs, they won’t be enough for one person to eat. She saves the pasta for another day.

One and a half week later she find the pasta deep in the fridge and throws it in the bin.
ANALYSE
PROBLEM AREAS

Planning: Planning the shopping and cooking is a big problem. We don’t have time and don’t realise it is a problem that we spoil food. There is not a big personal need for planning better but there are a need in the task of reducing food waste to plan better.

Knowledge: The knowledge on and around food waste is one of the biggest problems. We don’t realise that we spoil food and we don’t understand why it is bad and how it effects our environment.

Storing: The storing of food is connected to the planning of food. We forget what we have at home and what we should buy which leads to that we buy too much food that we don’t have time to eat. Another problem is that we don’t have the knowledge on how to store the food correctly which leads to that the food lasts for a shorter period of time.

Flow chart analyse: The process of the food can be divided in three parts, shopping, storing and cooking. The storage of the food can then be divided in three parts and future focus areas: make food last longer, keep track on the food and plan the meal/shopping.

FUNCTION LIST

A list of functions that is needed or desirable. This was made to determine what’s important and what functions that is needed. It is used during the ideation phase as a tool to evaluate and reconnect to the research.

POSITIONING

This project’s aim is to create a product that increases the awareness of food’s durability and the planning of the food. The aim is to reduce the food waste in the households.

<table>
<thead>
<tr>
<th>Function</th>
<th>HF</th>
<th>DF</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce food waste</td>
<td></td>
<td></td>
<td>N</td>
</tr>
<tr>
<td>Allow flexibility in planning</td>
<td>DF</td>
<td>D</td>
<td></td>
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<tr>
<td>Allow flexibility in storage</td>
<td>DF</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>Increase awareness</td>
<td>DF</td>
<td>D</td>
<td></td>
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<tr>
<td>Allow individualisation</td>
<td>DF</td>
<td>D</td>
<td></td>
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<tr>
<td>Keep track on the food</td>
<td>DF</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>Allow planning (before)</td>
<td>DF</td>
<td>D</td>
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<tr>
<td>Inform and remind</td>
<td>DF</td>
<td>D</td>
<td></td>
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<tr>
<td>Give tips</td>
<td>DF</td>
<td>D</td>
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<tr>
<td>Optimize consuming time</td>
<td>DF</td>
<td>D</td>
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<tr>
<td>Simple to use</td>
<td>DF</td>
<td>N</td>
<td></td>
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<tr>
<td>Keep food last longer</td>
<td>DF</td>
<td>N</td>
<td></td>
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<tr>
<td>Keep food fresh longer</td>
<td>DF</td>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>

*HF: Head function  DF: Sub function  N: Neccessary  D: Desirable
CONCLUSION

User
To reduce the food waste is a complex task. The problem is that we don’t realise that we waste food. We have to change our behaviour throughout the whole food chain to reduce the waste to zero. We can’t see how we gain anything from stop wasting food and that’s why it often slips our mind. What we need is a service or product that informs, increases awareness and helps us remember to eat what we have at home and make it easier to plan our meals.

Food
There are different approaches to how we can reduce food waste when it comes to the storing of food. We can either make the food last longer and therefore we have more time to eat it. Or we can keep track on the food we have so that we don’t buy too much or forget what kind of food we have at home. When it come to keep food last longer it all depends on the temperature. To lower the temperature and have the optimal temperature for the specific type of food can make it last twice as long.

Why storing?
Temperature has a big effect on how long food can last. According the answers in the survey there are not many people using application that are for plan the grocery shopping. Because of that and the temperature will this project focus more on the storing of the groceries in the home and not before the groceries come in the home. By keeping track on and using the food we have at home we will know what we have and we don’t need to buy so much new food that we not going to eat. By optimizing the temperature the food will both last longer and taste better.

Chosen direction
The focus in this project will be during the storage of the food. It will focus on how we can keep track on, use the food we have and how to store it correctly. By doing that we can get more aware of the problem and our behaviour.

Delimitations
This project will focus on storing fresh groceries that need to be stored cold because statistically this is the type of groceries that spoils the most. The project will focus on the product. If an interface is needed it will only be example and not a fully developed interface.

Increase awareness
Optimise temperature
Simplify the experience

How?
Increase awareness, optimize temperature, simplify the experience

Who?
Families with children.

When?
During the storing of the food.

Why?
To reduce the food waste and get more aware of our behaviour.

Where?
In the households.

What?
Refrigerated and perishables goods.
Ideation
This part of the process contains the development of the concept. Based on the research and specifications five concepts were developed. These concepts were then evaluated with collaboration partners and users and refined into one final concept.
**Ideation**

**Own Brainstorming**

Before the workshop, an own brainstorming was held. Every thought was put to paper. These are the most interesting ideas.

**Evaluation**

All the ideas were evaluated based on criteria like new thinking, effectiveness, realism, simplicity, and development potential. Five of these got the highest score and were developed further. See attached file.
Workshop

This workshop was about brainstorming in group. A group of eight people was collected and was asked two rather open questions.

- How can we remember what kind of food we have at home?
- How can we make the food visible?

The participants got 5-10 minutes to answer these questions, either write or draw. The goal with the workshop was to start a discussion and get some new ideas and inspiration for further ideation.

Workshop evaluation

After the workshop a evaluation was made by marking the most realistic, the most new thinking and the most innovative ideas. Below are some of the most interesting ideas.
CONCEPTS
EARLY CONCEPTS

After evaluating the workshop and brainstorming five early concepts was developed.

Concept 1
This concept contains of two parts. One add-on camera that’s attaches in the fridge. This camera send and analyse pictures and are connected to the second part. The fridge totem. This totem tells you with the help of its colour and shape how the inside of the fridge is feeling. If there is any food that needs to be eaten.

Concept 2
This concept is a food storage box that has a sensor in the lid and detects when the food are about spoil and need to be eaten. This can communicated to you with the help of colour or sound. The food container gives you warnings if the food are about to get spoiled.

Concept 3
This concept is a service that helps you keep track on the food you buy. Connect it to your pay card or take a photo of the recipe and you get all of your groceries in your phone. Can it be connected to the food scanner at the food store?

Positive:
Simple, pictures while shopping, engages children.

Negative: How to know what is spoiled, to childish

Positive: Keeps food fresh, keeps track on the date, gives warnings, easy access to the food, easy to see what’s in the fridge

Negative: How to keep track on the food outside the box.

Positive: Know all groceries not only fridge, get warnings.

Negative: How to get food out of the system?

Set date to remember when you put it in the fridge.

Gives notification when food are about to expire.
Concept 4
The fourth concept is a new kind of fridge. It has many compartments where it is possible to divide the food in the right temperature. Each compartment has a safe atmosphere for the special type of food that is in there. Each compartment can be adjusted in temperature and depending what is needed. Freezer, fridge or just cool temperature. The fridge can be connected to a service that keeps track on the food for you.

Positive:
- Right temperature, safe atmosphere, keeps track on the food, control from away.

Negative:
- How to know the right temperature.

Concept 5
The last concept consists of two parts. The first is a sensor that is installed in the existing fridge that keeps track on the food in the fridge. If the food starts to get spoiled the sensor can smell this and tell you via a indicator on the fridge door. The indication can be shown by colour or shapes on the fridge door. When you then open the door the fridge will show you what grocery are about to go bad so that you can use it.

Positive:
- New thinking, isn’t stressful, notice by yourself.

Negative:
- Does it actually work?, How do we know what product is bad? Only shows when it is bad.

First evaluation
The concepts was evaluated by the users, Peter Andersson, Jérôme Esteve, Torbjörn Malm at Electrolux and myself. Before showing the concepts for the users I combined the concepts and developed the concept 4 and 5 further. This resulted in two new concepts that was shown to the users.
The first concept consists of two parts. The first is a storage box that you put food in when grocery shopping and is being kept in the fridge. The storage box has a gas detector built into the lid. It senses when the food is getting bad and lets you know before it goes bad so you still have time to eat it. The second part is a food scanner positioned on the fridge. When packing the food in the refrigerator it is scanned by a camera which records all the food that goes in and out of the fridge and connects to a service. The service allows you to see what kind of food you have in the refrigerator. It is this service that alerts you when the food must be eaten.

The second concept is a fridge freezer. The refrigerator has different compartments. Each compartment can determine the temperature. Everything from freezing temperatures to defrost, fridge and room temperature. When the food is being stocked the refrigerator scan it and gives you a question: When are you going to eat the food? Based on what you answer the refrigerator sets the temperature automatically to an optimized temperature. When it is time to eat the dish you have planned the refrigerator adjust the temperature for you. Before the refrigerator changes the temperature it asks you if you still plan to eat the planned dinner. All compartments can be both freezer and refrigerator, which means that when a lot of freezing space needed some of the refrigerator space can be turned into freezer and vice versa. The refrigerator know which foods are added into it, and when it was put through the scanner, and keep track of it for you. The refrigerator can give you tips on dishes you can cook with the food you have and tell you that you probably should eat the broccoli that you bought a week ago.

When grocery shopping:

![Image](1008x213 to 1035x231)

**FRIDGE WARNING**

When do you want to eat the salmon?

- Yes
- No

**TIP**

Combine the salmon with the spinach that is one week old.
EVALUATION

SECOND EVALUATION

Users evaluation

The concepts was evaluated by the users. They got asked the questions:

- What is positive and negative with each concept?
- Which concept would you find most useful?
- What concept would you use?
- Which concept do you think is best and most interesting?

The overall opinion was that they liked concept 1 the most. Based on prize and accessibility right now. For them concept 1 was easiest and most realistic. One thought on concept 1 is that it takes time to put everything from the original packaging and put it in the storage boxes. An other thought was that it would be good to have it integrated in the fridge. The most liked part in this concept was the date feature. To remember when the leftovers from is a good thing. Concept 2 was according to the users an interesting idea and also a good choice but a bigger investment. In both concepts the idea of keeping track of the food with the help of a service was enjoyed. It is considered easier to start with the food storage boxes, they are pretty cheap and not a big investment.

“Bigger investment with a new fridge, the boxes are a good and easy start”

Jennifer Thimper, mother of two.

Function list evaluation

Even though concept one was the most liked by the users it was not sure that this was the concept that actually would work best and reduce the food waste the most. The research showed that to lower the temperature in the fridge and to store the groceries in the optimal temperature can keep the food last twice as long. This was discussed with collaboration partner and tutors. To find out which concept that solved the problem best I did a evaluation based on the function list that was developed earlier in the process. The evaluation showed that concept 2 fulfilled the criteria the most.

<table>
<thead>
<tr>
<th>Function</th>
<th>Concept 1</th>
<th>Concept 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce food waste</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Allow flexibility in planning</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Allow flexibility in storage</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Increase awareness</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Allow individualization</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Keep track on the food</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Allow planning (before)</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Inform and remind</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Give tips</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Optimize consuming time</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Simple to use</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Keep food last longer</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Keep food fresh longer</td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

“Concept 1 integrated in the fridge”

“Most of the food I throw away is already cooked food.”

“Notification in the phone is stressful”
**CHOSEN CONCEPT**

**SECOND EVALUATION**

Smart food storage
The concept that where chosen was the second concept, Smart food storage. The concept has the best potential when it comes to keep the food safe increase the knowledge of accessibility of the food. The research showed that part from knowledge and awareness does the temperature have a big impact on the lifetime on the food. With this concept it is possible to optimise

Function list
A new function list was created when the final concept was set. This contained more detailed functions that was important for this particular concept.

<table>
<thead>
<tr>
<th>Function</th>
<th>Satisfactory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy access</td>
<td>N</td>
</tr>
<tr>
<td>Allow storage</td>
<td>N</td>
</tr>
<tr>
<td>Fit to kitchen</td>
<td>Ö</td>
</tr>
<tr>
<td>Food for family (200 liter)</td>
<td>Ö</td>
</tr>
<tr>
<td>Allow temperature change</td>
<td>N</td>
</tr>
<tr>
<td>Different compartments</td>
<td>N</td>
</tr>
<tr>
<td>Store food in right conditions</td>
<td>N</td>
</tr>
<tr>
<td>Allow flexibility</td>
<td>Ö</td>
</tr>
<tr>
<td>Increase awareness of the content in the fridge</td>
<td>Ö</td>
</tr>
</tbody>
</table>

Floor plan
A floor plan was sent out and the users got to fill in where in a kitchen they would like to store food. The general answer was in middle, close to stove and with a worktop space nearby.
DEVELOPMENT

New scenario
One of the thoughts from the users in this concept was that a lot of planning was needed. A new concept was created to make the planning and handling of the product easier and more flexible. See next side.

Change of main target group
The original target groups was families with children and single households because statistically this is the groups in society that spoils the most food. Later this was demarcated to families with children because it is a target group that would most likely have the time, economy and motivation to invest in a product that helps reduce the food waste. Now with this concept it is possible to open up the main target group to single households as well. Food storage is something everyone is in need of and this solution could for example also be installed in student dorms etc. It is a concept that doesn’t require a lot of effort if not wanted and the user can put the food waste reduction on a level that suits them.

At grocery shopping:
1. The fridge is connected to your pay card you use at the store.
2. All groceries are collected in the application.
3. At home, press stock food.
4. The fridge shows which compartment the food should be stocked based on temperature.

(Application):
1. You can cook salmon with bulgur-apple salad:
   - 100 g Salmon
   - 1 Apple
2. Salmon
3. Apple
4. Milk
5. Get recipes and tips on what to eat.
6. When one recipe is cooked, cross it from the list and the groceries will disappear from the food library.
7. Control the fridge from work and away from home.
How a fridge works

To keep a fridge cold two things is needed, insulation and a cold module. The insulation usually is made of foam and or vacuum panels. The more insulation there are in a fridge the less energy is needed to keep the fridge cold. The cold module can be constructed in three different ways, with a compressor, a absorption (gas fridge) or electrical (peltier fridge).

Compressor

A compressor fridge consists of five components, fluid refrigerant, a compressor, condenser coils, evaporation coils and an expansion device. The fluid refrigerant goes through the compressor that raising its pressure and pushes it to the condenser coils outside of the refrigerator. When it meets the cooler air outside the refrigerator it turning into a liquid. The liquid now has a high pressure and cools down as it flows to the condenser coils inside the refrigerator. It absorbs the heat inside the fridge and cools down the air inside. In the evaporating coils the liquid turns into gas again and flows back to the compressor through the expansion devise. Then the cycle start over again. In the most simple fridge-freezers this technique is used to cool down the colds part, usually the freezer and then a door is used to control the airflow between the part to control the temperature. In the more advanced fridge freezers there is separate cooling systems for the different compartments. A compressor fridge uses a small amount of energy to keep the fridge cold.

Absorption

A absorption or gas fridge work almost in the same way as an compressor fridge but instead of a compressor heat is applied to a generator to heat up amonia and water instead of the liquid in a compressor fridge. When the mix starts to boil it goes through the seperator where the amonia gas is seperated from the water and then goes through the evaporator and cools the fridge and then back to the absorber where its mixes with the water again and the cycle repeats. This system uses no moving parts which makes it quiet.

Electric

The electrical fridge uses the peltier effect to keep the fridge cold. Electric power goes in to a semiconductor which get warm on one side and cold on the other side. The cold side is then used to cool the fridge. This type of cooling system is thin and doesn’t take a lot of space but it is very inefficient and 2/3 of the energy is lost as heat energy.

Chosen direction

After discussing with Olof Björkqvist, Ph.D., senior lecturer in energy engineering for the best solution the compressor solution was chosen, but instead of a gas flowing in the system it will be a liquid. Each compartment have a thermostatically controlled valve that controls the flow of water to that compartment. This is the most efficient way of cooling and allows each different compartment to have individual temperatures.
For people to use this product it’s needed to be really simple to use. The interaction has to be clear and intuitive. To give the appearance of simplicity and trust.

The product need to be able to fit in different homes. To do this it needs to be discrete and integrative and melt in to the surroundings. The material meetings are clear and materials are clean.

The third direction is to make the product furniture like. This is to get a contrast to the modern and clean feeling and get away from the kitchen appliances direction. The shapes are soft and lightweight.
First Sketch Phase

Colour, Material

To keep a fridge cold two things is needed, insulation and a cold module.

Evaluation

The sketch phase went in two directions. One with a standing food storage solution and one with a storage solution on the wall. After evaluating this with users the solution on the wall was chosen. This will make the food more visible and accessible, it is better ergonomic. By placing the cupboard on the wall it is possible to be more flexible in the placing. The homes today gets smaller when more people are moving into the cities. The wall placings is suitable for restricted kitchen area when you don’t need to build the kitchen around the fridge. This solution also fits with the floor plan that was sent out earlier. By having the food storage on the wall the concepts will be more like a piece of furniture than a kitchen appliance and that was the original aim with the appearance of the project.
SECOND SKETCH PHASE

Sketches
After the first evaluation more sketch exploration was made, fast Photoshop and CAD sketches for a more realistic appearance. The top sketch in the right corner became the key sketch for this project and key point for the rest of the form exploration.

Key sketch

SECOND SKETCH PHASE

Detail sketches
Full scale projection
The different compartments have to fit different types of food. To test the size of the compartments, a full scale projection was made and tested with food of different height and dimensions. The marked areas are good sizes for the compartments and what was used at the decision of the measurements in the finished product.

How many compartments?
The cupboard will have seven compartments. This allows for all temperature zones that are needed and also to be a bit more flexible in the temperature handling in the food storage.
Full scale model
To get a feeling of the size of the food storage a full scale mock-up was built. Here was different sizes of the radius on the corners tested. Also the deep of the cupboard was tested to get the right dimensions.

MEASUREMENTS

Modules
The food storage is part of a modular system with three other parts. One part with drawers, one that is standing and one that has two bigger compartments that are good for high bottles etc. This system allows for the user to adjust the storage to their needs.

Measurements
All modules has the same external dimensions 600x1000 mm. The volume is ca 140 litres, (smaller than according to the function list) this will allow a one person household to store food for a week and a family of four can store the most fresh food or their everyday groceries. The biggest compartment in the standard cupboard is 400x300 and the smallest 200x300 mm. By making the cupboard this small it is possible to be more flexible in the placing. The homes today gets smaller and smaller when more and more people are moving into the cities. This restricted kitchen area is also a reason for having smaller modules. Depending on how much storage you need and how much space you have you can have two or more modules.
Colour, Material
Based on the previous moodboards a cmf-inspirationboard was created. To fit into many environments and living spaces the product needs to be neutral in its materials and colours. The product is a product that will last long, at least 10-15 years.

Clean
- Glossy to see dirt / prints
- Smooth to be easy to clean

Furniture
- Wood, classical material
- Glass, light weighted feeling

Discrete
- Discrete colours
- Natural materials

Light
- Enhancing lights

Detail / Material Testing
Details such as split lines and cuts on the cover was tested. The aim was to give it an interesting and inviting appearance. The chosen gives a discrete feeling and leads the thoughts towards a piece of furniture.
Colour testing
The colours palette will be neutral and discrete to fit into a kitchen. It will be a mixture of matte materials on the cover and glossy materials on the inside. The chosen colour palette gives a lightweight impression with a light board that frames the main body. The white handles gives a captivating contrast against the glass doors.

SERVICE

Wireframe
A part of the wireframe was made to see examples of functions that will be included in the application. Here it is possible to control the temperature and frosting, see recipes, list of the food and get tips and trix on how to reduce the food waste.
Result

In this chapter is the final concept presented and explained. This is Smart food storage. This is the concept that was developed in the ideation. In the end there is a conclusion about the project and the end result.
This is Smart food storage. It is a concept that helps you remember your food and store it correctly for the best optimized experience. The fridge sets the temperature automatic depending of what food you have inside. By connecting the fridge to your phone you can get tips on recipes, see what groceries you have at home and easily be able to control the temperature and frosting in the doors. This adds the versatility of a smart product connected to the internet of things. Because of its size it is a flexible product. It can easily be placed in dining rooms or kitchens without the need of refurbish.
The smart food storage is not a regular kitchen appliance but a piece of furniture with a new function. It is a smart food storage that allows for a new way of thinking when it comes to food. To display the food will make us more aware of how we behave and how we treat our food. The transparent doors motivate us to make use of the food we have before we buy new.

Smart food storage is a modular system where you can choose the setup and type of storage after your needs. There are four different modules. Two wall-mounted, one vertical and one horizontal. One with drawers and one with bigger compartments that are good for high bottles or groceries. All modules have the same dimensions and can be arranged as best suited. Depending on living space you can have one or two or more cupboards to fulfill your need.
**UNPACKING FUNCTION**

The fridge are connected with the application. When you have been grocery shopping just press the unpack button on the control panel and the fridge will show you with a small icon on each door in which compartments to put the groceries in. It adjust the temperature automatic for the optimal temperature. You can also decide to change temperature manually inside the fridge or via the application. The fridge has the capacity to go from -22°C to +15°C.

**FROSTED FUNCTION**

To get a good overview of the content of the fridge the door are made out of glass. The glass can be frosted or clear, you set the wanted amount of frosting on the control panel or in the service. This allows for showing of your food or hide it and improves the visibility of the content. By not open the door every time you want to look inside it saves energy.
Control panel
The control panel is located at the front bottom. From here it is possible to control the amount of frosting on the glass, and access the unpack mode.

Ventilation panel
At the bottom of the cupboard there are panels for ventilation, these are removable for cleaning etc.

Shelf and storing boxes
Electrolux has a series of door shelves/boxes made out of plastic. These storing boxes can be mounted on the inside of the walls to easy organize smaller items like small jars or sauce bottles.
**FUNCTION**
**EXPLODED VIEW**

**Cooling function**
The food storage is cooled with a compressor and a cooling battery where a liquid are running through the condensor and cools the fridge.

**CMF**
**COLOUR AND MATERIAL**
The cupboards are available in three different colours, wood, grey and white. This will allow for individualization and flexibility.
SERVICE
APPLICATION

The service helps the user to plan meals and to keep track on the food. It includes functions such as recipe search, tips and trix for keeping the food fresh. You can also control the temperature and frosting from here. If you want to dig deeper into how to reduce the food waste can you use the function of listing the food you have at home and read all about easy ways and thought on how to waste less.
SCENARIO
HOW IT WORKS

Step one:
Connect the application to your purchases via your pay card. Now you get all your purchases directly in your phone. Before grocery shopping use the application to see what’s missing and make a shopping list. When you pay the fridge will see which groceries you have with you.
Step two:

When you get home, press the unpack button and the fridge will show you in which compartment to put your food.

The fridge optimizes the temperature automatically but if you still want to change it just connect via the application or do it manually in the fridge. Here you can change temperature from -22°C to +15°C. You can also decide how much frosted glass you want the doors to be from here.
Model building
The model was build in PU- foam and was milled, hand maid and painted.
The initial aim of this project was to reduce food waste in the society. The research showed that by planning better and optimize the temperature we store our food in we can reduce the food waste to almost zero. The final result is the smart food storage. It reduces the food waste by optimizing the temperature and visualize the food in an appetizing and inviting way. This will invite us to get motivated to make use of the food we have before we buy new food. The additional service helps keep track on the food in the fridge by being connected to your purchases. This will simplify and inspire for the planning of the grocery shopping. All this will increase the awareness and motivate and inspire for further actions to reduce our food waste.
Referenses: Part 1 (background, fact about food)

Links:

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