UMAD

Utgått MatAvfall Datering

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Reducing organic waste by implementation of smart packaging

In the report delivered to the Norwegian Parliament by the Ministry of Agriculture and Food dated 2008 – 2009, organic waste was emphasized as the waste category with the highest growing rate in Norway. The households produced 500 000 ton of organic waste, while the service industries produced 400 000 ton. High percentage of the organic waste could be either eaten or prevented to become waste.

Organic waste is first of all waste, which takes a lot of resources to deal with, but it is also a result of non optimal usage of resources. By reducing organic waste it might be possible to save the environment for the pollution connected to production, distribution and consumption of food in Norway. The Government has acknowledged this as a major environmental challenge and is using high amounts of resources to fund project working towards the reduction of organic waste.

To reduce organic waste it is important that the manufacturers deliver high quality products. Although it then might seem that much of the responsibility lies in the hands of the manufacturers, all the links in the food supply chain have to be optimized in order to reduce

the waste.

Background for UMAD

Due to the fact that two of the group members have jobs and experience within grocery stores, the group has seen with their own eyes how much waste is produced by a grocery store every day. One of the projects presented in the beginning of this course focused on reduction of organic waste in households via consumer awareness. We ourselves wanted to focus on the distributing link of the industry. Many of the larger grocery stores in Norway have to hire people whose main tasks are search and removal of product that are past their expiration date. The product needs to be rotated in order to front the oldest product and sell them to the costumers. The tension zone consists of conflicting goals and needs between the stores, who want to sell all their products before they expire, and the consumers, who want the freshest food available which equals financial loss for the stores. Even though the foods expire on a given date, they are still eatable, but according to Norwegian law (url 1) the service industries are not allowed to sell them past the expiration date. If the stores cannot manage to rid themselves of the perishable foods in time they are wasted without profit for the stores and adding to the growing amount of organic waste.

Our main goal is to help grocery stores with improving their efficiency regarding handling foods and reducing of the organic waste. Our solution is intelligent packaging. UMAD wants to exploit the potential that lies in RFid. We want to equip food packages with RFid that will contain information about the expiration date and will notify the employees at a grocery store about the approaching expiration date through small readers placed on the shelves. The notification will be displayed on mobile screens through an app or at the company computer which will allow them to take appropriate action - to set the price down (encouraging customers to buy the product at a lower price) or remove and give it to ideal organizations may have interest in collecting the food. We believe that by providing them with a solution that will be cost efficient and to their benefit, we might help the reduction of organic waste and subsequent environmental nuisance. The option to give away the food that is still eatable to charity will also reduce the waste. As far as we know, the stores have no objections to give away the food to charity, but lack the resources to notify the various organizations about the available foods.

Research question

How can intelligent packaging help to reduce organic waste in Norwegian grocery stores?

Users

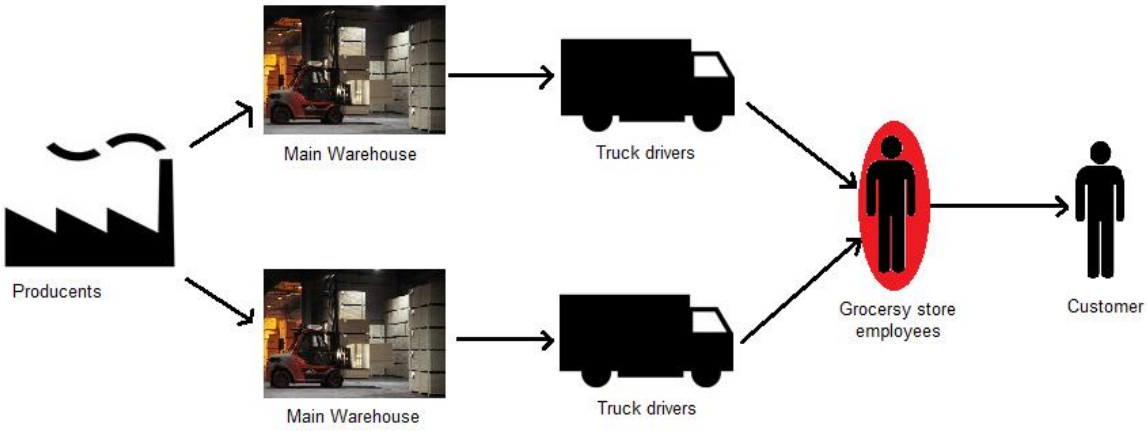

Figure 1 – Food chain

Our goal is to reduce organic waste in grocery stores. We wish to focus on the most obvious target group which is the grocery store employees. After going through the data collected through our research we found out that reduction of organic waste cannot be obtained without consideration of all the major components of the delivery chain. Perishable foods can get a shorter expiration date when subjected to changes in temperature. This can happen on the way from the factory to the main warehouse, truck drivers might follow poor routines when delivering the foods and even costumers might leave the products in unsuitable places around the store or mix up the packages which are usually placed with the shortest expiration date facing the customer. Our solution therefore regards all of the actors presented in figure 1, but the focuses of this project are the grocery store employees who deal with handling foods. The employees are our users and it is their needs and wishes we intend to meet.

Methods

Focus group

In conducting our research, we invited some of the representatives for our target group to a focus group. Our main motivation behind using focus group prior to other methods is that we wanted to map the existing routines around food products with short expiration date in different chains. We had prior to conducting the focus group already gathered the broad data consisting of statistics provided by the Norwegian government and SSB, but wanted to use the focus group to interpret the data and dig further into the existing problems (Morgan 1996).

Although Morgan (1996) argues that individual interviews might be more fruitful in terms of idea generation, in case of focus groups, the participants both query each other and explain themselves to each other. In addition "such interaction offers valuable data on the extent of consensus and diversity among the participants" (Morgan 1996: 12). We wanted know exactly why and how service industries produce so much organic waste.

From comparing our own experiences regarding the routines for handling these products, we had an idea that different food ventures have different routines and policies. Therefore the people we would like to talk to will come from three different grocery stores representing different franchises. Our goal was to include five employees in charge of ordering and handling perishable foods.

An additional motivation for using focus group is that wished to include our users in the design process as early as possible to design a solution that corresponded with their needs and fit the context of their work. One of the main advantages of focus groups is to give voice to the people (Morgan 1996), therefore we didn't have a strict manuscript to structure the meeting, and instead we will tried to cover the subjects of interest to us (see appendix for the list). The results of this meeting stood as our primal data in the design process.

Interview

To gather information regarding the framework and peripheral context of our solution we have conducted two interviews. We have interviewed a representative from Nofima (see "Findings from the interview", p.6), and a representative from ThinFilm. The interviews were semi structured to allow free flow of mutual ideas and we did not want to constrain their answers in any way.

Prototype testing

After we had gathered the data and designed a prototype for our solution, we invited our users to prototype testing. Together with ethnographic studies, presentations of possible design solutions are methods used in participatory design. In order to evaluate the solutions and hopefully improve them it is helpful to include the users (Bratteteig et. al. 2010). We provided the users with a tangible prototype. We wanted them to evaluate if our solution would make their work more efficient and if the solution was easy and intuitive to use.

Consent forms

During collection of the data through interviews, focus group and prototype testing we asked the participants and informants to sign a consent form (Appendix 2 for consent form for the interviews) in order to participate. We did not record any of the interviews or conversations. All participants were informed that they would be anonymous and that they could under any circumstances withdraw from the project without giving any reason for that.

Theoretical framework and reviewed literature

What is intelligent packaging?

The article "Intelligent packaging: Concepts and application" by Yam, Takhistov and Miltz, discuss the definition of intelligent packaging and the difference from active and smart packaging. It is also an overview of the technology and application of it in packaging.

Yam and others (2005) define intelligent packaging as a packaging system that is capable of carrying out intelligent functions to facilitate decision making to extend shelf life, enhance safety, improve quality, provide information, and warn about possible problems. According to their definition, a package is "intelligent" if it has the ability to **track the product**, **sense the environment** inside or outside the package, and **communicate** with human.

Yam and others (2005) also defines active packaging, which is like intelligent packaging a system designed to enhance shelf life, but the difference is that the product, the package, and the environment interact in a positive way to achieve some characteristics that cannot be obtained otherwise. While smart packaging devices they defined as small, inexpensive labels or tags that are attached to primary and more often onto secondary packaging to facilitate communication. Examples are RFID (Radio Frequency Identification Device), barcodes,

time-temperature- and gas indicators and biosensors. The smart packaging devices are one of the main reasons for the birth of intelligent packaging concept because it enables the package to acquire, store and transfer data.

They also attempt to explain the role and importance of intelligent packaging and how it differs from traditional packaging. While it traditionally has facilitated the flow of materials, intelligent packaging also facilitates the flow of information. This flow can promote more mobility by enabling more efficient delivery and production cycle.

What technology exists?

If you search "intelligent packaging" on Google Scholar, you'll get 91 700 hits. Most of the articles talk about active and intelligent packaging together as one concept. Most of the research articles are written around 2004-2006. The majority of the articles conclude that there is a need for further research for intelligent packaging. For example suggest Yam and others (2005) that it should be done more research in the interaction involving food packaging, food engineering, biotechnology, microelectronics, software engineering, nanotechnology, and other disciplines and that there is a need for a better integration of intelligent packaging in the total packaging system. As we are now in 2012, we believe that the technology in this area has been developed or changed since then. There is an obvious gap of research of intelligent packaging technology in the last years. But what we can see by the food research trends is that there has been an increased interest for a more holistic approach to researching the complete supply chain, from farms and to the trash or recycling. One of the largest projects is ForMat (url 2), which is a national collaboration between the government, corporate and grocery store chains with aim of reducing food waste, through research and innovation. Another major research project in Norway is SmartVareflyt (url 3), where a web based platform has been developed to track products tagged with RFID.

The most common smart packaging device in grocery stores is barcoding. Barcodes are cheap, and barcode scanners are cheap too, which makes it popular, but it can contain limited amount of data (Yam, Takhistov & Miltz, 2005). RFID-technology is a small chip with a unique numerical sequence, easy to scan as long it's within the range and possible to combine with GPS (url 4). RFID have the advantage of barcoding in that the tags can hold up to information with a storage capacity of 1 MB, be placed in the packaging without affecting the data and the ability to track gives much better inventory information (Kerry, O'Grady & Hogan, 2006).

Problems with existing implemented intelligent packaging

One of the main challenges is the increased cost of intelligent packaging. It is difficult to persuade people start using it (For an example: url 5) unless it is free or helps reduce overall expenditures. Moreover, the technology hasn't been globally standardized. E.g. RFID from US, Europe and Japan are not compatible (url 6), making it impossible to use the technology in grocery stores with imported goods from around the world.

The prototype

As explained in the first part of the report, our solution is based on data from smart packaging read by small readers integrated in the shelves that is sent to the store's PC. Our prototype presents this interface. We started our work on prototype development by drawing some simple wireframes on a white board while discussing different use cases. Thereafter we developed our prototype using the prototyping tool delivered by axure.com. Since we wished to test usability, we did not give too much attention to the esthetical and graphical aspect of the design.

The main page contains the logo for UMAD and by clicking anywhere on the welcoming page the user is transferred to the store view (figure 2 in appendix) where the user can click on the part of the store where there are foods that require execution of appropriate routines. The user might get a list over the products or click on the relevant fridge. Fridges needing attention are marked with tags with appropriate colors. When wanting to print the list, users were presented with a list of products (figure 3 in appendix) which itself was challenging from a design perspective due to the concerns regarding which categories we wanted to preview and which the users would find helpful when walking back into the store to handle the alerts. If the users wanted to view the relevant fridges, they were presented with what we will refer to as shelf view.

In the shelf view we decided to go for a picture of a store-fridge with shelves containing foods (figure 3in appendix). Our idea was that an implemented solution would replace the standard, blurred out picture we used in the prototype with an actual shelf from the store. The products in the picture are all marked with three types of tags based on their color:

- Red representing foods expiring the current day
- Yellow representing foods that needed cycling or moving into another area.

- Green, telling the user that the food did not need any intervention.

These objects are also explained in the floaters in each page view (figure 4 in appendix). We used colors associated with traffic lights to use the culturally shaped affordances. Though we did not find a way to implement this in our current prototype, we did think about having small hovers over each icon containing the color information in order to help employees with color blindness.

In our prototype the objects are set to different phases and users might check off the products that have been handled, or use the button to the right for the shelf view in order to check off all the alerts. The other buttons next to the shelf view give the users an opportunity to print out the product list for the current shelf as well as the shelf view. We included that function grounded in the information drawn from the focus group. The informant pointed out that we should include such function in case some stand ins or new employees were supposed to execute the task and were not familiar with the store.

We also included a help page where the users could read about all the features of the system.

Findings

In the following chapter we would like to present the findings from our data collection using the methods described in the chapter regarding methods.

Findings from the 1st interview

We have conducted an interview with a representative from Nofima (The Food Research Institute). Our goal with this interview was to find out what Nofima had to do with packaging and to map if they have used RFID in any of their projects. The interview was conducted at Nofima in Ås with all UMAD project members present. During the interview we got an insight into the main purpose behind the enterprise. Nofima specializes in food packaging and looks mainly at the interaction between the food, packaging and the consumer. They use technology and their knowledge to find better ways to preserve foods so it is eatable as long as possible, which the interviewee presented as the main goal of food industry.

We wondered if Nofima had much experience with intelligent packaging. Although they had not implemented much smart packaging in their work, they have their eyes open for new solutions. The informant emphasized the main challenge regarding implementing smart

packaging which is higher cost than traditional packaging. Unless the producers see a direct benefit following the implementation of smart packaging, the project is doomed to fail. Simultaneously the interviewee stressed that the retailers have a lot to say and sit on sanctions which might press the producers if they themselves find the solution beneficial for running their own businesses.

Around the problem regarding food waste, the interviewee stressed the question: who pays for wastage. It is important to se the money flow. If the products being delivered are of poor quality or are damaged, the producers are the ones to pay the bill, if the product bypasses their expiration date, the stores end up losing their revenue. If the product sold is of poor quality and the person to discover it is the customer, s/he ends up on the losing side. Therefore, the interview subject suggested that RFID should contain information that could be used on as many links of production and deliverance as possible in order to increase the demand for such solution.

The discussion continued towards what kind of information might be appropriate to include in the solution. The interviewee informed us about the possibilities in collaboration with ThinFilm. She presented the idea around including temperature log in the RFID. In this context she suggested that Nofima can contribute in terms of interpret logs like that and present data for the users when using the RFID. Temperature has much to say for how the food is preserved. Just by allowing a package containing perishable food to stand in room temperature for an hour decreases its shelf life by a day. By including the temperature log in the package, it would be easier to determine where a flow had happened and contribute to improving the routines around this specific link of production and distribution. The interview subject argued that just including the information about the expiration date is not enough and might be misleading due to the fact that much can happen that can reduce the shelf life. Other concerns that the researcher at NOFIMA informed us about is that solutions like indicators can make consumers trust too much on them, and this can cause more food waste. The indicators on the market today are not yet foolproof enough, and there is a danger of false positives of poor quality. The consumers have also different needs regarding the durability of the foods. Some may want to use a product during the same day while others might need a product that is durable for a longer period of time if they shop seldom or will not be able to shop for a longer period of time.

The last part of the interview touched up on the challenges regarding security and encryption. A challenge is to prevent any tampering with the data stored on the RFID.

Findings from the 2nd interview

After out 1st interview with Nofima the group decided to contact Thin Film, a company that specializes in printing memory cards. Our goal for this interview was to find out what Thin Films plans for intelligent package is, and when and if they plan to release their product for the food industry. 2 of the group members along with the informant from our 1st interview met up with the representative for Thin Film.

The group wondered who they main competitors are, and where the answer was the more traditional silicon based equipment. The main advantages with printing circuits instead of using silicon, is that it's a lot more cost effective. With printing you print 3d layers on top of each other, something that lets you create memory chip along with transistor to name a few components.

When it comes to competitors in the food industry Thin Film mentioned color label indicators as one of their main competitors, problems with those are that they can't store data, and they aren't as accurate. Our interview object also stated the possibilities for several modules on their smart labels, where you can have a display on the product instead of on the shelves, something that will let the store price each package individually depending on for example expiration dates. The labels can also be implemented with temperature sensor, something that will make it possible to actually make a more accurate expiration date for a product that what it is today.

Even if Thin Films products have some clear advantages over their competitors it also has some disadvantages. One of their main disadvantages over traditional silicon based equipment is that their memory chips can today only hold 20 or 40 bytes, but they are working on meeting the RFid standard of 96 bytes. With only 20, 40 or 96 bytes, there are limit for what can be stored on these chips.

What our interview object suggested that these chips could hold temperature measurements, for example max min, and an integral graph, that holds the value for areal for graph when it

exceeds a specific temperature. What this will allow us is to actually make a better expiration date for each package instead of the expiration dates that is put on each package by the food producers. If you take milk for example, storing milk at 8 degrees Celsius reduce it's shelf lives byhalf compared to storing it at 4 degrees Celsius. This have a lot of advantages for us consumers, but as our interview object points out, you can't be sure if the producers would like this implementation. One of the reasons for that is that we could end up with products that have expired before it's even brought into the stores if they have been handled and stored wrong before sent to a store. This can leave the producers with expenses if they have to refund to the stores if they handle the product wrong. But this can also be turned around to give advantages, for example when the producers are finished packaging meat, they get stored in freezers on pallets. The outermost packages will take around 8 hours to freeze, while the inner packages takes 45-50 hours before they are frozen. This will make the shelf lives shorter for the inner packages compared to the outer ones, something that both the producers and the stores can take advantage over, where they send out the one with the shortest shelf life 1st. having temperature sensors can also enable the store to optimize their store freezers seeing that the temperature will differ from front to back in the freezer, as well as different places can have different temperature. This will allow the stores to put the most valuable items where it's the coldest, and therefore extend its expiration date.

After the interview the group saw that we should in the beginning focus on the more expensive fresh food, and even if we see the advantages with temperature sensor to set the expiration date, there are laws that have to be changed before this can be implemented, and its not sure either the stores or the producer would like it even if it is a lot more time efficient. But to implement it for some form for quality assurance (QA) where the stores and the producers can change their routine can be more favorable, seeing it's in both interest to have a good reputation for selling good products.

Focus group

We did not get the desired amount of participants. Out of five candidates, only one could join us. Therefore the focus group meeting turned out to be a focus group- influenced interview. With experience as an employee for several years and a manager for he was well aware of the food waste problem. As a manager this occupied most of his time at work.

In his opinion the main cause for food waste was the human factor, there were ordered too much items. In addition there were poor packaging and poor food quality. What they did now

to reduce food waste was having routines where employees had to check the stores every day for expired items or move soon-to-be expired items so it can be more easily reached (also called “rullering” (en. “Cycling”). They are supposed to “cycle” for every new delivery, but it takes too much time. The he fresh food counter and meat counter and diaries had to pay detailed attention to.

They also used a portable computer system for aid, called Pocket. This system gave them an overview over average items they sold and automated the process of ordering food. The automation of this process decreased the amount of food waste and made it easier for employees to order new deliveries.

Prototype testing

For the usability testing we had four employees from grocery stores as participants. All of them were regular employees without managerial responsibility.

Upon their arrival, they received a short introduction of the concept with a descriptive scenario. Thereafter they got a few minutes to familiarize themselves with the prototype by exploring clicking around the website. When they felt ready, the participants got tasks where they were asked to “think-aloud”. When using the ’think aloud’ method, participants reported on incidents as soon as they happen. However, users tended to tell more of what they were doing rather than what they were thinking. Another issue that we were aware of is that people tend not to voice negative reports. We had follow up questions afterwards so we could ask in detail what we noticed they had problems with or confused about. Even though we got a lot more out of them, the follow up questions does not mean that we were able to cover all negative issues that the user may have had.

Results of prototype testing

The most confusing issue for the users were the icons on the shelf overview. They did not fully comprehend what the different colors of the icons represented and why they could change the colors by clicking on them. The short description at the bottom of the page was not informative enough.

The labels we chose were important for how the users understood the function. The labels for the dates in the printable product overview were understood differently than we intended. The

dates were the range of the expiration dates for every product with this product name. The participants thought this was the beginning date and the expiration date for this product.

The help pages were rarely or not used at all. There were several causes for this. One was where the link to the help pages was located. The link for the help pages was placed with the short descriptions of the icons which were not links. The majority of the participants reported not needing it. But some mentioned that they would have probably would have understood the icons better if they had used it.

The floor plan view was viewed very easy to use and understand. But some preferred to use the printable product overview anyway because items could be located several places and since they were familiar with the grocery store they worked in it was much easier to use the checklist when going around and doing the routines.

When asked about the advantages and disadvantages of introducing the system in their workplace the participants were in general positive because they perceived that it would save them a lot of time. One mentioned it might require more training of employees. This is important to consider in further development and implementation, because if the system require extensive training, this will be another cost for grocery stores, in addition to the cost of switching from old to new system. This will in turn make it harder to convince grocery stores to adapt the new technology when the cost is high.

After the first round of user testing we made a few changes to the prototype, to address some of the issues that arose under the testing. The usability testing after the redesign didn't give us sufficient data, but if we did, conducting usability studies after a redesign would have helped us determine if changes actually made a difference in the usability of the program.

Some of the issues were caused by the limitations of the prototype, mainly the print-out-function and the partly implemented floor plan view. Since the prototype did not support printing, clicking on print, led back to the last page, which seemed to confuse the user.

Discussion

In the following chapter we would like to first of all discuss and argue why our solution fits in the mobile systems world. Our argument is based on the three aspects of mobility presented by Kakihara and Sørensen and the two articles from the syllabus regarding ubiquitous technology. The chapter will also present how we included universal design in the solution and what the limitations to this project are.

The Mobility Concept

When the group started out with this project, one of our main concerns was if this could be seen as mobile concept. We all saw the term mobile being the same as spatial mobility, where we move from one point to the next, something our solution did not offer. After reading an article by Kakihara & Sørensen called *Expanding the 'Mobility' Concept* we got introduced to two other dimension of mobility, where the dimension called temporal mobility did fit our project. The essence in temporal mobility is that you make technology more time efficient for the user, so they save time. What we would like to do on the structural aspect is to implement RFid into food labels, and equip each shelve with RFid readers. This will enable the stores to always be aware of when the different food expires, and also when products are placed in the wrong shelves. This system will let the users check for misplaced or close to expiration date products when they need to use a computer, and they no longer need to plan when to check for products that will expire soon. In the article they are referring this as going from monochronicity where you do one thing at a time, in a structured order, to polychronicity where you are less structured and are enabled to multitask in a broader way. We are hoping that the different stores can see the value of what this system can offer, where the main point is that they don't need workers to manually go over all the products, and this saves the stores labor hours. It can later on be implemented into the cashier's check out where the customers can pay themselves, and the stores can manage with even less workers. In his article, "The computer for the 21st Century", Mark Weiser explains the concept of "ubiquitous computing" and the disappearance of technologies into the background (1991). He argues that virtual reality does not have to exist only inside a computer. He tells about his vision of computers imbedded in walls and everyday objects. Ubiquitous technology requires technology here categorized in three parts: cheap low power computers, software for ubiquitous applications and a network to tie these together (Weiser 1991: 22). Our solution somewhat satisfies these requirements. The user interface on the work PC and the electronical readers connected to the

network and interacting with the system. Our users can still feel as if they are just in a grocery store while at the same time be surrounded by the virtual reality and technology.

Expiration date based on temperature sensors VS labels

When we 1st started to work on our prototype there were several limitations we had to consider, mainly limitation in the laws when it comes to expiration dating and how the employees use the systems they got now.

The group decided to not use the expiration date based on the temperature sensor, but rather use the expiration date that's showing on the package. The main reason for this decision lies in the fact that incompatibilities will occur when changes are made, and the bigger the change is, the bigger the incompatibilities between the old and the new system will be (Hanseth & Lundberg, 2001). One of the biggest incompatibilities that would occur using the new way of finding expired food is that a store can't keep food that's been kept properly, and have a longer actual expiration date than what the packaging is saying. Something that would mean they can only throw away food that have been kept below the ideal conditions, and also the employees would have to go and check all the food manually as well, since it wouldn't have detected when packages are near the packages labeled expiration dates, but the expiration date calculated with the temperature sensors.

Paper solution?

Our solution gives the users the possibility of printing a categorized list of products that need their attention in order to not become wastage. In relation to this, we considered what kind of systems they already have, and what kind of routines the employees have now. There are stores that operate with programs that are meant to monitors the temperature in the different freezers. These programs can be made so that each freezer/fridge is mapped according to where it's standing in each grocery store. This function is something the group decided to implement into our prototype as well, so that the main page can be made specifically for each grocery store, to show a map for each freezer/fridge. When it came to how we should show the food that needed attention, the group designed two ways of showing this, a graphic one, showing the freezer/fridge, and the food that needed attention, and a list which could be printed. The reason why we implemented the possibility for a printable list was that a lot of the routines being done in a store are already based on different printable lists. When they get new deliveries, they get an inventory list for what they got. When you approve expired food, it's also list based to name a few examples. When we tested the prototype we also got

feedback from the testers that they preferred the list over the more graphic solution we made. Old systems will put constraints on the design of new ones (Hanseth & Lundberg, 2001).

We discussed if we should provide an app for the users that would allow them to get the list on their smart phones. We were immediately faced with a dilemma. The first one was the privacy of the data. Should every user have their own username and password in order to be able to access the list? Without a login option it would be possible to distribute the list to anyone. Secondly, the mobile phone provided a challenge with regards to micro-ecologic flexibility. It would become another object between the employee and the physical task. Last but not least – most of the stores in Norway have a strict anti-cell phone policy. It's not good for the store's reputation to walk around the store with a cell phone no matter what the cause was. But who knows? Perhaps in a few years cell phones and other mobile devices will be more acceptable at the work place. Our design is open for auxiliary and additional functions.

Universal design

Being employed at a grocery store, our users seldom have special physical needs which could lead us into thinking that we did not have to give much attention to universal design. Despite this, during the development and design of the prototype we kept in mind the Web Content Accessibility Guidelines 2.0 (url 7). Although the result of this project is merely a prototype, we strived after making the content of the UI perceivable, and even though the prototype may not be perceived as graphically advanced, we tried to make it as easy to separate from the background as possible. We did not include buttons non-text content so it could be changed into other forms people needed. The feedback from the users confirmed that the UI was operable and understandable. We did not include colors or functions that might cause a seizure. We fine-tuned the prototype to include possibilities for the users to reverse their actions and navigate through the site. We also tried to make the UI appear and operate in predictable ways. Our opinion is that if our solution would be implemted, it would require even more attention to universal design regardless of who the end users might be.

Limitations

Although we got good feedback on the prototype, there are, however, several limitations to the current report. The relatively small sample from just a few stores, especially regarding the focus group and need specifications may lead to biased assessment of the needs and use cases of grocery store employees. The fact that the invited informants, who the focus group consisted of, were daily managers could affect which functions we ended up including in the

prototype. Presenting the users with a prototype which seemed like it was a complete solution might have affected their feedback, hindering them from being more creative, critical and suggesting changes in the prototype. Another limitation is that we did not have the technology which is still being developed internally in ThinFilm, so we had to explain how the technology would work. In addition, we conducted our user data collection at IFI, which is a different space and context, which might have limited their responses.

Last but not least, we got the idea for our solution early in the process which might have affected the questions and methods used in our data collection. Having two of the grocery store employees as group members might have also led to another way of understanding the data since we were familiar with the routines and terminology in grocery stores and did not need so much explanation from our users. Nonetheless, it is clear that there is a big potential for reduction of organic waste within the service industries and our solution represent one of the many solutions that could be implemented in the future stores. Additional study is needed to test the generalizability of the findings from this report.

Conclusion and the road ahead

In "Re-Place-ing Space: The Roles of Place and Space in Collaborative Systems", Harrison and Dourich make a distinction between the term "space" and "place" arguing that space is the three-dimensional environment in which objects and events occur, while place refers to the understood reality – we are located in space, but we act in place (1996: 69). With our design and solution we are not really affecting the space itself – we are trying to change the place. We are relocating the activities that are currently happening between the aisles in grocery stores to remote desktops and changing the routines thereby the place. The employees at the grocery store will now move around a virtual reality (Weiser 1991) and check for expired foods using mobile terminals or a computer instead of ravaging through the store's shelves. We wish to not to fill the virtual world with analogies between media spaces and the real world by trying to digitalize the store and threatening the employees' work identity – we wish to embrace the things that make the place work – the shared understanding (Harrison & Dourish, 1996).

When we first started on our project, we thought that the solution would only be limited to the grocery stores. After conducting the interviews, focus group, user testing and the literature review we became aware of the complexity of our case. The questions yet to be answered are if we can get the employees to change their existing routines, like to sit in front of a computer

and follow the products, something that has until now been limited to store managers. Will the possibility of printing out the list over the expiring product give the users sufficient ecological flexibility (Luff & Heath 1998)?

In order for our solution to work, the employees need to mark off where the routines have been executed. If somebody marks them off without actually doing anything with the products, it will not help to reduce the waste produced by the store. In order for the concept to work, everybody needs to play by the rules (Holone et.al 2008). This also requires big amount of trust towards the employees.

Even though the solution does not intend to store any personal information, in the future implementation attention should be given to the privacy risks (Rhodes et.al. 1999). One can imagine that by keeping a log of the temperature one may connect the people responsible for the products to the time of the change in the registered values. In addition, as designers we do not have absolute power over how our solution might be used in the future – perhaps it will lead to increased supervision of the workers or cause that some workers might lose their job.

Looking at figure 1 one can see a rather high number of actors. Another big question is how can we get the producers on board to implement the solution, do we have good enough incentives?

Our project embraced the technology that might be a standard in the future. During the course of the project we have broadened our understanding of mobile solutions and how they affect users and the context. Our opinion is that intelligent packaging is an interesting field that needs more attention and offers a great deal of possibilities not only for increasing the revenue for the stores but also for reduction of organic waste and thereby saving our environment.

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Appendix

Appendix 1

Themes for interviews

- Laws
- Use cases for smart packaging
- Examples and other projects resembling ours
- Producers - why should they implement our solution; how do we get their attention
- Have you had any luck with implementing your own solutions?
- What information do we need to store at the RFIDs?
- Cost - benefit

Agenda for the focus group (20.10.2012)

Introduction

Part 1- Questions

- How do you order the foods?
- What is the biggest cause of organic waste at your store
- How much is being wasted
- Routines

Part 2 - Presentation of UMAD solution

- **Our solution**
- **Any ideas?**

Part 3 - Invitation to prototype testing

Appendix 2

Samtykkeerklæring for intervju i INF5261 prosjekt

Beskrivelse av prosjektoppgaven: Vi er en studentgruppe i kurset INF5261: Development of Mobile Systems ved Institutt for Informatikk, Universitet i Oslo. Prosjektgruppen består av Stian Bratlie, Margaret Machniak og Bao Marianna Nguyen. Kursleder er Jo Herstad, e-post: johe@ifi.uio.no.

Prosjektet vårt har intelligent emballasje som sitt hovedtema. Dermed, som en del av prosjektet skal vi undersøke hva slags informasjon det er behov for i en emballasje for å redusere matavfall i serviceytende næringer.

Frivillig deltakelse

Deltakelsen er frivillig og du kan når som helst trekke deg fra intervjuet, uten å oppgi grunn. Vi bruker ingen form for opptak, men vi tar notater, og skriver ned så mye som vi kan i etterkant av intervjuet.

Anonymitet

Notatene samt innleveringsoppgaven, vil bli anonymisert, dvs at informasjonen ikke kan knyttes opp mot deg, i den grad det er mulig.

Før intervjuet begynner, ber vi deg om å samtykke deltakelsen ved undertegne denne erklæringen.

Samtykke

Jeg har lest og forstått informasjonen vedrørende dette intervjuet og gir mitt samtykke til å delta. Jeg forstår at jeg når som helst kan trekke meg fra dette intervjuet.

Dato:

Signatur:

Appendix 3

Screenshots of prototype

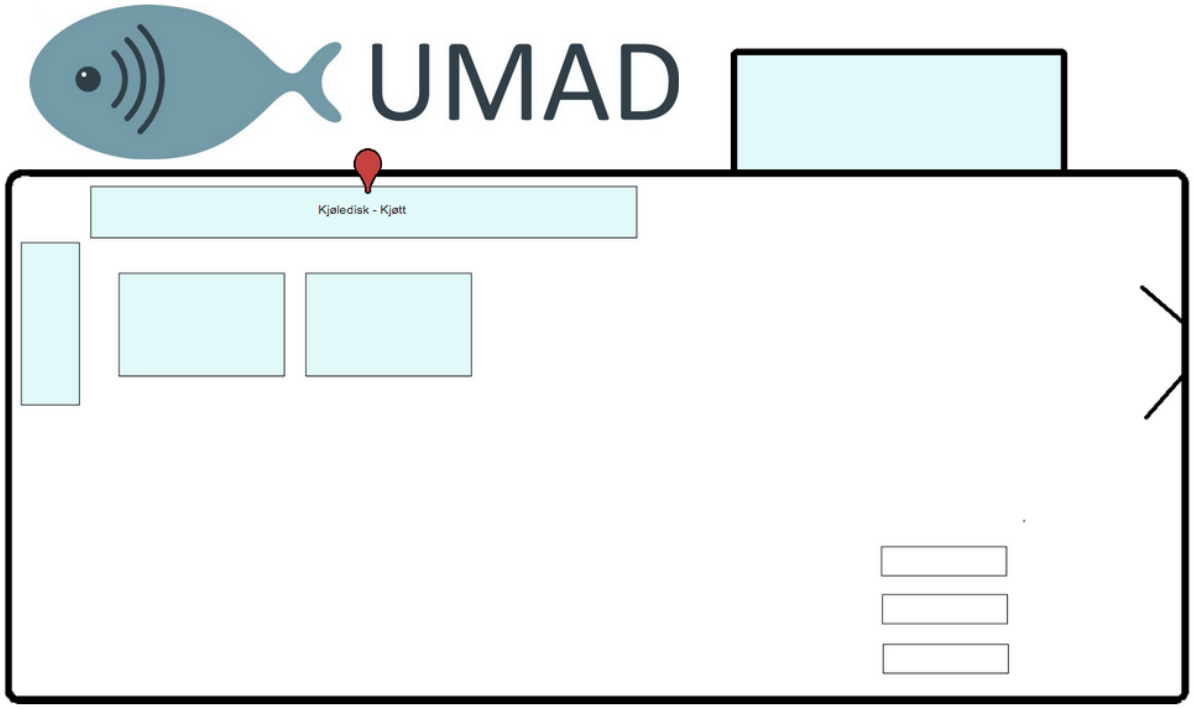

Figure 2 – The floor plan

Figure 3 – The shelf overview

Print

Kjøledisk	Produktnavn	Dato fra	Dato til	Antall
Kjøttdisk	Gullsalami	12.nov	13.nov	5
	Nordfjord pepperskinke	14.nov	15.nov	10
	Nordfjord Wienerpølse	12.nov	12.nov	6
	bacon	12.nov	12.nov	2
	go' og mager leverpostei	15.nov	15.nov	5
	Nordfjord kjøttpølse	14.nov	16.nov	12

Figure 4 – The printable product overview