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 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 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. According to ForMat's website, service industries have managed to reduce the organic waste by 9% since 2007 (www.nhomatogdrikke.no/format), but there is still a long way to go.

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 it and store it in case 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?

Methods

Focus group

In conducting our research, we would like to invite 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 would like to map the existing routines around food products with short expiration date in different chains. We have already gathered the broad data consisting of statistics provided by the Norwegian government and SSB, but would like 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 want to 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 is to include five employees in charge of ordering and handling perishable foods.

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

Interview

To gather information regarding the framework and peripheral context of our solution we have and will conduct at least two interviews. We have already interviewed a representative from Nofima (see "Findings from the interview", p.6), and will now try to get in touch with a representative from ThinFilm and hopefully a representative from the ForMat initiative. The

interviews will be semi structured to allow free flow of mutual ideas and we do not want to constrain their answers in any way. In case we can't get face2face interviews with representatives for ThinFilm or the ForMat initiative, we will base our data on mail correspondence with them.

Prototype testing

After we have gathered the data and designed a prototype for our solution, we would like to invite some of our users back for 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). Our goal is to provide the users with a tangible prototype they can try out in the field. We would like them to evaluate if our solution will make their work more efficient and if the solution is easy and intuitive to use. This will be the last stage of the design process before the final solution.

Consent forms

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

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 (http://www.nhomatogdrikke.no/format/), 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 (http://www.sintef.no/Projectweb/Smart-Vareflyt/) 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 (http://www.sciencedaily.com/releases/2011/10/111013111127.htm). 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: http://en.wikipedia.org/wiki/Radio-frequency_identification#Wal-Mart_mandate) 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 (http://en.wikipedia.org/wiki/Radio-frequency_identification#Regulation_and_standardization) making it impossible to use the technology in grocery stores with imported goods from around the world.

Findings from the 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.

Discussion

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 checkout where the customers can pay themselves, and the stores can manage with even less workers. A problem with our solution is that even if the stores see this in a positive way, the workers may become afraid to get laid off, and then decide to try to sabotage the system.

The road ahead and awaiting challenges

During the next few weeks prior to the delivery of our solution, we are going to conduct the interviews and focus groups. The main challenge will be the design and development of a prototype which the users can test. 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 won't really be affecting the space itself – we are trying to change the space. 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 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 – 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 interview 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. Another big question is how can we get the producers on board to implement the solution, do we have good enough incentives?

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http://www.nhomatogdrikke.no/format/

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: