Barriers for sustainable waste management practices in grocery stores

Exploration by Research-through-Design

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Since natural resources are limited, we need to ensure that materials are reused and recycled to the highest degree possible. Information and feedback as well as incentives may encourage people to alter their behavior. In this paper, we explore waste practices within grocery stores and how feedback through visualizations may help stores improve their waste management. We have studied the gap between current waste data and waste data that is both meaningful and can be acted upon as well as barriers between actionable data and organizational change. Nine interviews were conducted with a central facilities manager, store managers, employees and a representative from the waste collection company. Based on the results from these interviews, two mockups of web visualizations were designed and later evaluated in two additional stores. The initial interviews highlighted knowledge about waste, economic and environmental incentives for recycling and current modes of feedback and comparisons between stores. The mockups also reveal structural tensions between economic and environmental goals that wouldn't be affected solely by better visualization of data. We conclude by discussing obstacles that needs to be overcome to reach organizational change in terms of more sustainable waste management practices in grocery stores.

Key words—waste management practices, data visualization, grocery stores, research through design, design mockups.

I. INTRODUCTION

Reducing waste is one of the low-hanging fruits in changing current production and consumption practices to strive for a more sustainable society. Reduced waste is beneficial both in terms of decreased inputs (resources) into production processes and in terms of decreased outputs (pollution, including CO_2 and other GHG emissions). Reduced waste could mean many different things. It could mean buying less or moving towards a circular economy that aims at keeping products, components, and materials at their highest utility and value at all times [1]. This means that disposal should be the action of last resort and that a bouquet of other actions are preferable to disposal. These are, for instance, *recycling* of materials, *refurbishing* (remanufacturing), *reuse* (redistribution), *repairing* or *sharing*. Zooming out, examples of materials that should be decreased or *at least* be recycled and that are

handled in a modern grocery store are food, wood fibers, plastics and chemical (e.g. batteries, fluorescent lights etc.).

Although disposal of material in general is a challenge for decreasing impact on the climate, issues surrounding food waste stand out as particularly burning. This is probably because practices pertaining to *food waste* are surrounded by strong feelings regarding the necessity and the value of food, about people's right to have access to sources of nutritious food, the "immorality" of throwing away or destroying food. Food is also an interesting and provocative area of inquiry since the current agricultural system contributes to biodiversity loss [2], ecosystem degradation [3] and is also a large emitter of greenhouse gases [4].

While much research on food and sustainability within Human-Computer Interaction (HCI) often focuses on individuals or household choices (with some exceptions, see for example [5]), there has been less focus on other phases in the food supply chain, such as the grocery store. However, since large-scale benefits could be obtained by moving "upstream" in the supply chain, the grocery store has a central position in both the current as well as the future food chain. Within research on sustainable consumption and production, the role of food retail in current or in future sustainable societies has been thoroughly investigated [6]. Since food retail is situated in between producers and consumers, it has a key role and can influence both upstream (producers) as well as downstream (consumers), by promoting green products. In short, retail can have a decisive role when it comes to establishing sustainable practices in the food sector.

In this paper, we report on a study of waste management practices in a Swedish grocery chain and its attempts to decrease the waste stream. This study resulted in two design mockups for systems intended to support reduction of waste in grocery stores; one to support store managers' decision-making and one to provide store employees with feedback on waste-related practices in the store. We, furthermore, go beyond the direct results of the study and discuss potential barriers, such as conflicts of interest hindering progress towards developing less wasteful and more sustainable grocery stores. The specific research questions to be explored in this paper are 1) the gap between currently collected waste data and actionable data and also 2) barriers between actionable waste data and organizational change. By "actionable data" we mean data that not only is meaningful to the user but also easily can be acted upon.

II. BACKGROUND

Sustainability within the retail sector has become an increasingly central concern over the last years. Retailers experience pressure from governments, legislation and from increasingly concerned and aware consumers to take a more visible interest in the social, economic and environmental impacts of their activities [7]. Swedish retailers are mainly motivated to engage in sustainability work by financial incentives such as potential savings [6]. In terms of waste, it is generally up to the individual store owner to decide what investments to make. It is also up to the store to decide whether to improve the quality of waste sorting and the routines for monitoring inventory and quality of food in order to minimize losses due to expiration dates [6]. Both of the two largest grocery chains in Sweden, ICA and COOP, have launched initiatives to reduce food waste by selling food with a short expiration date at a lower price point and by donating food to charities [8], [9].

There are both drivers and barriers for retailers to implement sustainability initiatives and these are typically categorized according to 1) regulatory, 2) resource, 3) market and 4) social factors (see further [10] for a typology). For example, two common *resource drivers* for engaging with sustainability strategies are the potential for cutting costs and for strengthening the brand name. Lack of financial resources or lack of expertise to carry out interventions in the sustainability area are examples of *resource barriers* [10]. Waste management is considered to be part of the *regulatory drivers* and retailers should naturally abide to legislation concerning waste.

In the present study we have worked with a food chain in Sweden, and we will refer to it using the fictive name "Cesco". We also worked with a leading Swedish waste company which we will refer to

as "Clean-up". Cesco is one of the larger actors in the Swedish food retail market and they have a sizable share of the Swedish market. A waste management agreement was implemented regionally in 2016 in approximately 300 Cesco stores together with the waste collection company Clean-Up. Besides handling Cesco's waste, Clean-Up also generates statistics about amounts of waste collected and costs per store and per category. Although the statistics can show that some stores are better at sorting waste than other stores, this feedback is poorly communicated to the individual store manager unless central Cesco management specifically highlights and brings this up (for example in regards to outliers who are notably worse than others in controlling costs or in sorting their waste). When the agreement was implemented, internal goals were also formulated for the stores, stating that in 2018 all Cesco retail stores should sort their waste based on seven different categories: 1) staff-generated waste that is handled by the municipality, 2) corrugated cardboard, 3) plastic, 4) packaged foodstuff e.g. plastic-wrapped cucumbers or expired packages of meat, 5) hazardous waste, 6) glass and 7) combustible waste that is sent to incineration. The internal goals also stated that the combustible waste category should not account for more than 35% of the total waste. However, some stores have an inadequate waste management system, possibly due to lack of space, time and/or equipment or due to giving such tasks a low priority, due to regarding it as an inconvenience or due to lack of sufficient knowledge to make informed decisions.

Previous studies focusing on HCI, recycling and food have explored different perspectives, from social persuasion [11], [12] and holistic education systems [13] to robotic bins [14] and playful gamification systems [15]. Households' reflections about food waste and their disposal have also been explored through a food waste diary designed as an application, discovering the personal complexity behind reasons why food is disposed of [16]. The role of interaction design in relation to food in our everyday life has also been discussed in the HCI community [17] as has how ubiquitous computing can play a role in our food consumption practices [18].

A study of public waste recycling concluded that users need to become engaged on a deeper level and suggested several means to do so, e.g. improved visibility of recycling stations, of shaping disposal holes in the bins appropriately so as to improve the chances that items are sorted correctly as well as a reward system based on the amount of recycled goods [19]. Social persuasion and aversive effects have been investigated in relation to households' disposal of waste with some effect in terms of improved awareness and increased reflection about recycling as well as increased motivation to improve recycling skills [11]. An emotional connection to the bins in question can also be relevant as redesigning waste bins through anthropomorphic design has been shown to affect people's intentions to use them [14]. The unique contribution of this paper to the discussion concerns the connection between waste management and HCI on a grocery store level and with store staff and managers as the designated target groups.

III. METHOD

The study uses design as a central methodology to collect qualitative data and it therefore resembles a Research-through-design (RtD) approach. RtD views the design artifact as a tool for creating and investigating possible future scenarios. In lines with Frayling [20] and Gaver [21], we saw the primary value of the design process as the articulation of reflections surrounding and leading up to the designed mockups. We thus used design activities and their outcomes as research tools to construct new knowledge around waste practices within these kinds of grocery stores. In this way the design process forms part of the research process, but the main objective is the exploration of the *design space* - not the *design outcome*. The specific phases of the study were:

- *A. Collection of waste statistics and selection of stores*. Stores suitable for the study were selected according to their size, the amount of waste, and the reliability of waste statistics.
- *B. Contextual interviews with target group*. Following the RtD approach, the purpose of carrying out interviews with target groups is to identify drivers and barriers in regards to waste sorting and to generate ideas for prototypes.
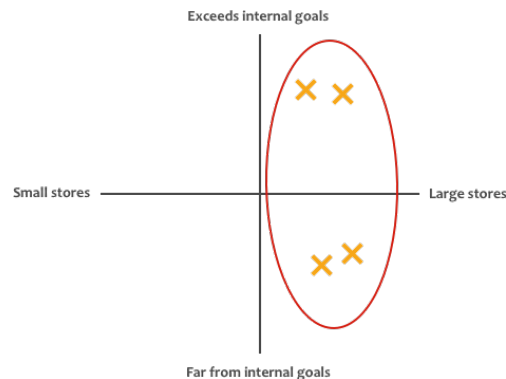
Fig. 1. A diagram of the four selected stores for interviews.

- *C. Concept development.* Concepts were developed based on interviews with target groups, complemented by an ideation workshop and final design by an interaction designer.
- *D. Feedback from target group on concept.* The final design was presented to the target group to elicit reflection and spontaneous reactions to the concepts presented. This final stage of the data collection for the study is intended to generate knowledge both concerning the concept designed and additional knowledge on drivers and barriers for waste sorting practices within grocery stores.

A. Waste statistics and selection of stores

Cesco and Clean-Up provided us with statistics about waste for each store and for each waste category. Based on these statistics we selected larger stores (that handle larger amounts of waste) rather than smaller stores. The selected stores were further narrowed down to stores that had reliable statistics for large waste categories such as cardboard, packaged foodstuff, combustible waste and plastic. Among these, four stores were selected based on their potential to improve their waste sorting practices, see figure 1. Two stores did not reach the internal goal of classifying less than 35% of all waste as "combustible". Two other stores were selected because they in fact *did* reach these target levels and we hoped that something could be learned from studying these stores in terms of finding significant differences in behavior and/or infrastructure.

B. Contextual interviews

Nine semi-structured interviews were conducted in the pre-study for the design phase. One interview was conducted with Cesco's regional central facilities manager who helped us to understand the statistics provided and his own role within waste management procedures. Another interview was conducted with a representative from Clean-Up to better understand their practices and their perspective on Cesco's stores' various waste management practices in relation to the stores' wildly varying "infrastructure" for sorting waste in terms of size, space, location, equipment, personnel, local conditions etc.

Seven contextual interviews were conducted in four different stores with four store managers, one employee and two warehouse managers. The purpose of the interviews was to explore the store managers' knowledge of waste categories, amounts of waste generated, costs and their motivation for improving sorting practices or for reducing the amounts of waste generated. We were also interested in trying to understand store managers' needs in terms of the amount of feedback, information and in terms of comparisons they received or would like to receive about their waste management practices. The goal of the interviews with employees and warehouse managers was to acquire a more practical view of the waste sorting environment and to understand what the waste paths looks like. We also wanted to explore the employees' knowledge of and perspectives on how waste sorting practices work, what kind of feedback they receive on their waste sorting practices as well as suggestions for possible improve-

ments. All interviews were recorded and transcribed. The interviews with store managers and employees each lasted about 20 minutes. The data gathered during interviews was analyzed using codes and summative phrases of sentences according to the descriptive phenomenological method [22]. The summative phrases were then categorized and used for creation of themes.

C. Concept development

Insights from the interviews were categorized and sorted into themes. The qualitative data was then used to develop the design concepts and prioritize among the ideas generated. To start off the ideation process, a workshop was held with three sustainability researchers. The purpose of the workshop was to brainstorm initial ideas based on the qualitative data collected and to document these ideas in sketches. The next step was to develop and refine ideas and to hash out possible developments and functions. The design concepts were divided accordingly targeting either store managers or employees - since these groups have distinctly different information needs. Two concepts were selected and further refined into more detailed digital mockups.

D. Feedback on mockups

The final two mockups were after some further refinements presented to potential users to get feedback and elicit reflections. This was done by visiting two stores not included in the prestudy but similar in terms of size and amounts of waste. The concepts were shown to two store managers, one warehouse manager and two employees. The two mockups were presented to the store managers and the warehouse manager while the two employees only saw the web visualization for employees. Each person was asked to verbalize their spontaneous reactions to the concepts, whether they understood the information that was presented, how relevant the information was to them and if they saw anything they considered irrelevant or uninteresting. The mockups were presented on a computer while we recorded the interaction on the screen and the user's voice with QuickTime player. These tests provided us with valuable feedback about the concepts and ideas including how they could be (re-)designed and developed further.

IV. RESULTS

The results from the study are threefold. 1) The initial interviews and store visits generated findings and themes about the waste management practices in the stores. 2) Results from these interviews also form the foundation for the creation of design concepts. The two resulting mockups were designed for different purposes and for different target groups. 3) We finally present the results from a user study of the design mockups.

A. Waste management practices in stores

The initial interviews indicate what type of knowledge store managers possess; their motivation and capacity to change their practices; incentives they find interesting; and what kinds of feedback they receive and/or would like to have.

1) Knowledge and Competence

Interviews with store managers revealed knowledge gaps in how waste was managed in the store. Individual store managers for example reported not knowing:

- What happens to the material,
- Costs for waste management,
- Names of waste categories used and what is included or not included in each category,
- Distribution between categories, and
- If restructuring the waste handling had had any effect on their sorting.

Two store managers expressed a need for guidance and follow-up on waste management costs while one store manager reported that even though he knew the ins and outs about waste management, he was just too busy to work with this issue. Warehouse managers also reported that it needs to be

simple to sort waste and that errors usually depend on laziness or lack of knowledge. The warehouse managers try to educate other employees about the importance of recycling and on what should go in which bin.

2) Motivation, priorities and agency

Store managers expressed varying degrees of motivation and interest in waste management, depending on personal interest and on which type of issues the stores were currently coping with. Two store managers had been involved in the decision-making process of how to design the waste management system in their stores, including decisions about bins and equipment. One store manager had high environmental ambitions but had no say in how the building had been designed. He said that he would have designed it differently had it been up to him. However, his preferred design would also have incurred higher costs since he wanted to "properly" recycle all kinds of waste. One store manager reported that the store was currently focusing on tidying up around the waste bins because of trouble with vermin. Another store manager reported that his store is more concerned with providing goods to the shelves and satisfying customers and that they had not been prioritizing waste management despite possible monetary savings:

"Well I do pay these bills. To be honest, I don't really look at them. And I am dead certain that we could earn more money on this. But I don't have that time really these days. Or, I haven't had neither the will nor the time." (Store manager 1)

Our interviews indicate that most store managers did not prioritize waste management. Even when one store manager did have the motivation and ambition to improve the waste handling, the supporting structures to actually do so were missing.

3) Financial incentives

A central theme that arises from the interviews is the store managers' focus on financial incentives. Store managers discussed both drivers and barriers relating to financial aspects of handling waste and discussed how economic and environmental concerns could point in different directions (e.g. could come into conflict with each other). To three out of four store managers, costs and rewards for sorting waste were central factors when thinking and reasoning about waste management practices. Reducing costs was a motivator although the waste management cost is relatively small compared to the daily revenue of the store. All store managers reported that sorting out cardboard generates money and they also had some notions of which categories were the most expensive to handle. Only one store manager said that he tried to educate the employees (in a previous store) by placing signs with information about the costs and incomes for different waste categories on the wall. The category with packaged foodstuff was brought up by all store managers as a critical category since costs incurred related not only to the costs for disposal but also for purchasing the goods themselves (that could have been sold in the store at a profit). This category is important for them to follow in their daily activities and the reduction of this category of waste is prioritized. This poses a dilemma for store managers who on the one hand wants to make sure that little goes to waste but on the other hand want to display fully stocked shelves in their stores:

"You tend to be along the edge anyway, there is that balance, that the customer needs to be able to shop goods as well, one can't keep it too tight in the shelves because of fear of throwing it away. There must be goods to shop, so that balance is difficult. Whatever you do it goes wrong" (Store manager 4)

4) Economy vs. sustainability

All store managers discussed the financial aspects of waste management. Economic aspects were a motivator for reducing the amount of waste and store managers believed there existed a potential for saving money. Some store managers framed economic concerns as obstacles for sustainability initiatives while others emphasized that the economic concerns and the sustainability concerns of waste management usually go hand in hand. For example, one store manager claimed that sorting waste into more numerous fractions can lead to higher costs due to increased transportation costs for a larger number of bins. Another store manager pointed out the difficulties of donating food to non-governmental organizations (NGOs) if foodstuffs needed to be sorted twice; once for deciding what

can and what can't be sold in the store and then again to decide what can and what cannot be donated. One warehouse manager discussed how sustainability is communicated in the company in terms of it being a trade-off between sustainability and economy:

I expect that we will get some sort of feedback [...] one thing they say is that 'this is really important because we should be good environmentally'. Money is all that controls and governs, I'd say. A bit cynical, but that is often the case. (Warehouse manager 1)

Store managers generally argued that economic and environmental incentives align when it comes to recycling and waste management. However, in those cases where there is an environmental incentive but not an economic one (or even an economic disincentive), they claimed to be less interested. One store manager emphasized the difficulty of running a supermarket while also taking environmental responsibility into consideration and pointed out the difficulty of trying to sell goods while simultaneously tackling overconsumption:

"Well in terms of sustainability [...] it is about keeping down those types of things and constantly work with selling away most of it, inform the customers about overbuying [...] But, it's kind of contradicting what I work with, if you're a good sales person then you want people to buy a lot but not buy so much that they will throw it away." (Store manager 3)

 5) Feedback and comparisons

Store managers and employees generally received scarce feedback on their waste management practices and expressed a need for better feedback and more follow-ups. Two store managers wished for access to economic feedback. One store manager reported that feedback in terms of percentages and of comparisons between his and other stores had been given only once. Two store managers commented that comparisons with other stores is a common strategy in other areas such as sales and that it would be valuable to provide comparisons about waste management since store managers are very competitive. The warehouse managers also saw comparisons with other stores as something that could trigger and raise stores that were "below the average". However, using comparisons was deemed risky by Clean-Up. Clean-Up argued that comparisons could be unfair since conditions vary a lot between stores and that comparisons furthermore could damage the relationship between stores. Due to large variations in conditions, such comparisons would not work particularly well as drivers for improving waste management practices in the stores. Stores could for example vary in terms of number of compactors, equipment, warehouse space, location, proximity to nearest recycling facilities and so on.
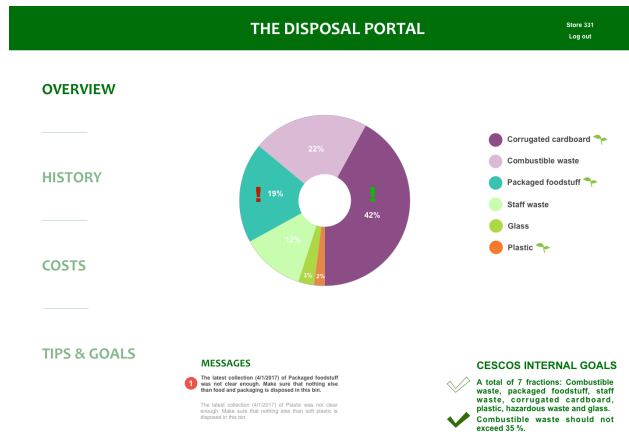
Fig. 2. The Disposal Portal for store managers, Overview section.

"And then I received a question, wouldn't it be interesting if they can compare themselves with other stores? And I said stop, that is really dangerous. If you begin to compare yourself, then it'll soon be "I am better than you", but it's not the same conditions. And then it might be a bad atmosphere, and then it's a "you're the worst". No, it's not fair. I don't think that the store managers should be able to compare themselves to one another. They should only be measured to a goal." (Representative, Clean-Up)

B. Mockups

Two main mockups were developed during the project, the Disposal Portal for store managers and the Disposal Portal for employees. The data gathered revealed functions that would be directly beneficial for store managers and these functions were implemented into a mockup of a website. As the store managers' and employees' roles differ, a version with simplified functionality was also created to display data that was judged relevant to the employees.

1) The Disposal Portal: store manager version

The Disposal Portal is a mockup of a website that is divided into four sections: "Overview", "Histo-
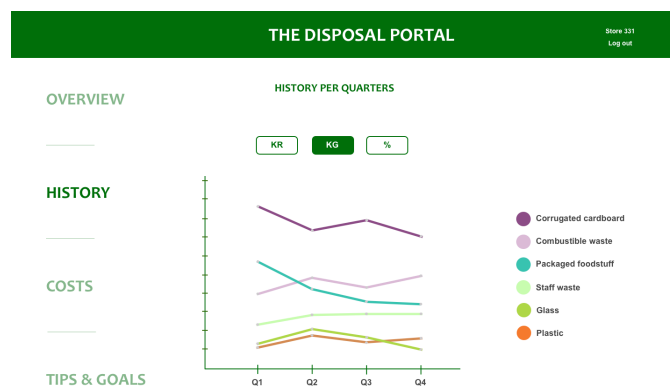

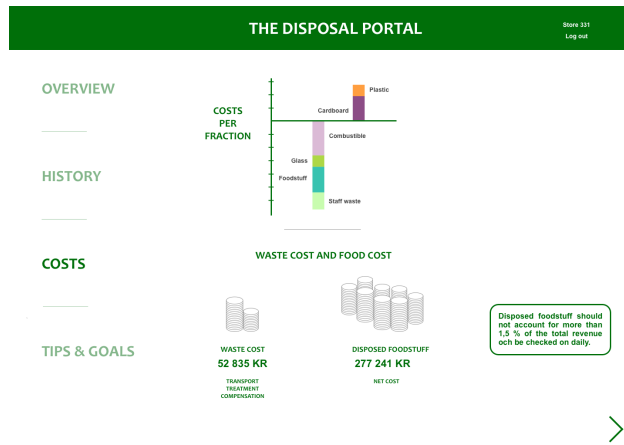Fig. 3. The Disposal Portal for store managers, History section.

Fig. 4. The Costs section for store managers, first view.

ry", "Costs" and "Tips & Goals". A quick overview of the waste categories and their percentage distribution is shown in the Overview section (see figure 2). In the History section (see figure 3), store managers can see the history of the waste distribution in terms of percentages, weights and costs to become more aware of developments over time, in terms of both waste management practices and costs.

Costs associated with waste management in the store are visualized through four widgets in the third section (see figure 4 and 5). The widgets show how much each category contributes to the total costs and incomes, the total costs for the waste management compared to the costs of disposing outdated or damaged goods, a comparison between the store's current costs for waste management and the average costs for similar stores and revenue calculations which estimate the amount of cardboard that "should" be disposed of in relation to the store's revenue (e.g. a certain revenue ought to correlate with certain amount of cardboard to be recycled).

The last section contains tips on how to improve waste management and the possibility of setting goals. Information is presented about *where* different categories of waste (cardboard, foodstuff) end up (incineration, recycling, biofuel conversion) as well as *to which* recycling station they are taken (see figure 6). The second page (see figure 7) in this section provides a visualization of the three largest
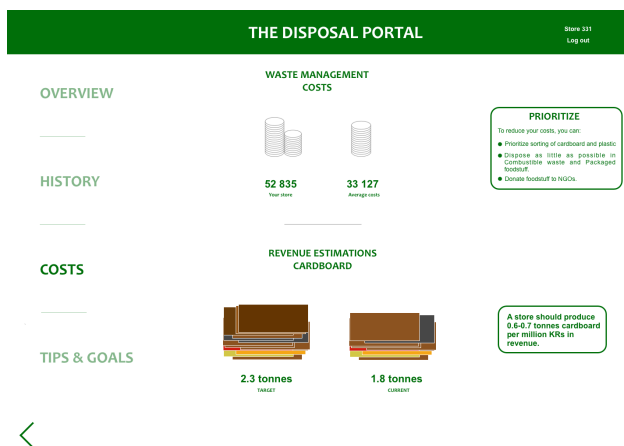

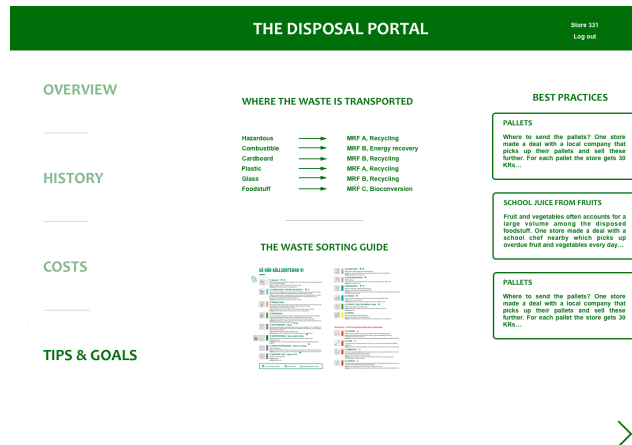Fig. 5. Costs section for store managers, second view.

Fig. 6. Tips & Goals section for store managers, first view.

categories of waste; corrugated cardboard, packaged foodstuff and combustible waste. The finished system should also offer suggestions for goals such as reducing the amount of combustible waste to a level that is comparable to other, similar stores.

2) The Disposal Portal: employee version

We also developed a version of The Disposal Portal that was more suited to the tasks and work conditions of employees in the store. The visualization is similar to the store manager version, but it has only two sections instead of four. The first looks like the overview section in the manager version (see figure 2) and the second shows a triangle with the largest categories of waste and the current goal (see figure 8). Instructions for sorting various categories of waste are also available in the interface. This visualization could be placed near the recycling area (for example with a touch screen) or as a static visualization on a screen in the employees' lunch room.

C. User reflections on the mockups

The design mockups were studied in two stores with two store managers, one warehouse manager and two employees. One store manager claimed that the overview section in the store manager version
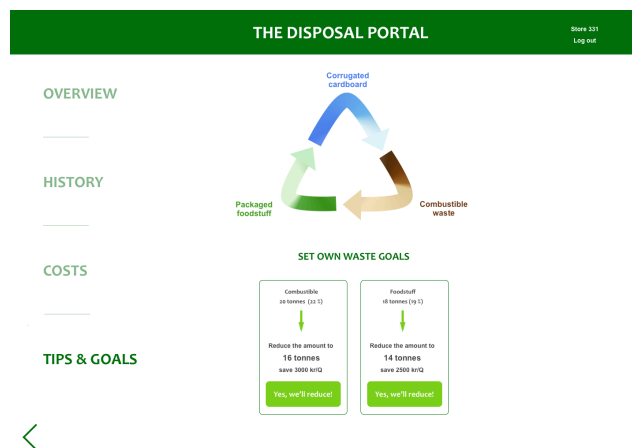

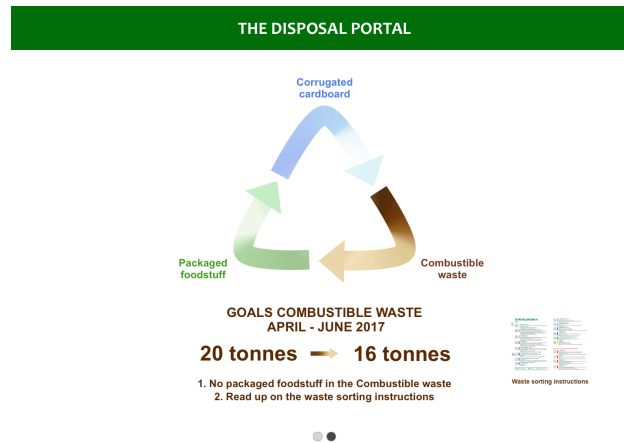Fig. 7. Tips & Goals section for store managers, second view.

Fig. 8. Tips & Goals section for employees.

did not add any value to his everyday work, but that it might be beneficial for communicating the overall distribution to his employees. The costs section was the most interesting section to the store managers as they stated that costs was the most important motivational factor. One store manager described the waste management costs as a "black hole". While waste costs pop up as items in his bills, it was not something he worked with actively. The costs for disposing combustible waste was seen as particularly interesting and constituted a possible behavior trigger for finding other types of solutions such as obtaining additional incomes by selling materials (e.g. wooden pallets that would otherwise be sent to incineration):

"And that I get the actual numbers for what I got back from the cardboard and what it cost to get rid of all the combustible waste, because those are the triggers that are needed to change a behavior and reach out to a company which collects the wooden pallets, to find a routine for that." (Store manager 5)

Store managers additionally expressed an interest in having access to information that would help them assess the costs of calling Clean-Up and order a waste collection. Although store managers flagged costs as the most important factor, they also expressed a concern about how to engage employees in these issues.

The Tips & Goals section received mixed feedback. The instructions for sorting waste were perceived as interesting and valuable. The store managers believed that instructions for waste sorting would be especially valuable for employees. However, store managers did not see why it would be relevant to know exactly which recycling facility their waste was transported to. Still, they thought it was interesting to follow what happens to "their" waste after it left the store. Best practices were regarded as interesting and valuable. Setting goals was perceived as a valuable function as long as the numbers are relevant and "reachable" by the store in question. One store manager especially liked that the system suggested relevant goals but desired feedback on environmental rather than financial impact when the costs were as low as 300€ or less.

1) Web visualization for employees

One store manager liked the idea of having a screen that visualizes waste data for employees placed somewhere near the loading dock. Another store manager thought the visualization would be more suitable on a screen in the lunch room since that is a place where also other types of information is displayed today. It was suggested that the visualization should also include weekly tips or advice that changed on a regular basis since small changes every quarter might not incentivize employees to look at the screen regularly.

Some employees felt they had no need for feedback on how they sorted different categories of waste. Another employee expressed interest in learning more if the data could be compared with another store in the same way as competition with a "sibling store" can be a motivator in other areas. Some employees expressed an interest in setting goals together with the store manager but doubted they would impact the distribution between categories without also putting more pressure on producers. The warehouse manager argued that it would be valuable to set goals together with the store manager since goals and follow-ups are common in other (non-waste management) areas in the store. The warehouse manager also expressed an interest in feedback on costs to be presented to employees.

"For example, today nobody thinks about the fact that it costs 8000 [800€] every time we empty the [food waste]. And the fact that we earn some money on [recycling cardboard], there's probably no one who thinks of that. And if you get a realization then, okay. Then I think it gets in the back of your head." (Warehouse manager 3)

V. DISCUSSION

The raw data available for Cesco's stores from Clean-Up is based on amounts of waste collected and the cost for that collection. However, not all that data is necessarily meaningful to store managers or employees, and there might be other kinds of data that is more meaningful. As store managers claim to be highly motivated by the possibility of financial savings, variables that are meaningful to them could for example be the total costs of different categories in comparison to each other. Actionable data in this context would be data that is both meaningful to stores and that can guide them to take action (see figure 9), e.g. the revenue calculations of the store in relation to expected amounts/values of corrugated cardboard which would then act as a reference value. While store managers also describe themselves as very busy, they have neither the time nor the incentive to look at the raw data and try and decipher how it could be used to improve their waste handling practices. We argue that a visualization with meaningful, easy-to-understand actionable data, could assist store managers and employees in improving their waste management practices.

A. Economy vs. environment

Although economic incentives are beyond doubt the primary drivers for any store-related behavior – including waste management – they are not the only incentives. While store managers agree that sustainability is important, they are primarily motivated if and when it aligns with economic incentives. To summarize, sustainability incentives are particularly motivating when they can be aligned with financial savings and cost cuttings, but, one store manager thought sustainability incentives were more relevant than economic incentives if the economic savings were only 300€ or less. This could be seen as his personal break point for where environmental concerns surpassed economic gains as a driver. But what happens when these two types of motivations deviate from each other or when they clash?
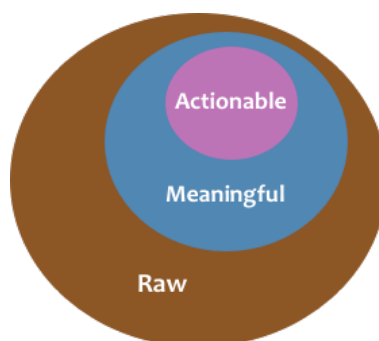

Fig. 9. The raw, meaningful and actionable data.

There are many actions that would be beneficial for sustainability but that would harm profits and there can at times exist an uneasy balance between these two goals. One example is the large volumes of food that have reached their expiration dates or that on a daily basis is thrown away due to visible damages. It can be hard for employees and store managers to throw away large volumes of food when they simultaneously know that food could feed people in need. One store gave away "surplus" food to the Stockholm City Mission and although it was seen as positive by the store manager and the employees, it still led to additional costs for sorting, for making sure the food was safe to eat and placed in the right place at the right time etc. If a partner (NGO) was unreliable and didn't pick up the food at the agreed-upon time, additional costs would accrue.

Another hypothetical example concerns the costs of separating plastic film from foodstuff. The right thing would be to separate the plastic wrapping from each cucumber before it is composted, but the comparatively high salaries of store employees in Sweden would make the costs of such an environmental action prohibitive. It can and will not be done and many other actions - hypothetical or real - could be added to a list that would enumerate conflicts between doing what is right "for the planet" versus doing what is right "for the wallet".

While store managers were motivated by financial savings, employees also need to be engaged as they are the ones who do the actual sorting of waste. If employees are more interested in the environmental feedback, measurements such as "trees saved", or kilograms of CO_2 saved could be used in the employee mockup. It should not be problematic to use different incentives depending on the target group as long as both employees and managers agree on the same goals.

B. From data to organizational change

In the study we discovered several barriers to making data actionable and to making the organization more sustainable in regards to their waste management practices. Actionable data, again, refers to data that not only is meaningful (to users), but that can also easily *be acted upon*. More data and better feedback *may* drive change by increasing knowledge about costs, about distribution and about other processes and it can be relevant in helping stores prioritize actions. However, if profits and costs are consistently prioritized, there is little chance that practices will significantly change for the better. Unfortunately, we have to draw the conclusion that waste management in general is a question that has a relatively low priority in larger stores since the possible financial savings are low compared to the daily revenue and compared to other actions the store manager and employees can take to increase sales and profits. Therefore, if change is to be realized it is crucial for waste management and recycling to be a prioritized issue at higher organizational levels.

Sometimes it is hard to calculate the value of certain actions sustainably and economically. For example, it might be profitable to educate employees about how to improve their waste sorting, but education also brings costs. It might even be possible to justify economically in terms of branding and the value of having a more sustainable profile, for example by aiming to become "the most sustainable grocery chain". In future work, we recommend further investigation of incentives for employees to engage in waste practices and to study where in the organizational structure support can be found for grocery stores to reach sustainable waste management practices.

VI. Conclusion

In this paper, we have explored waste management practices and especially the distance between meaningful waste data and actionable data as well as barriers for organizational change towards becoming a more sustainable grocery store. Contextual interviews in stores and with organizational representatives yielded that knowledge about waste management is lacking, that economic aspects are of particular interest to store managers, that store managers and employees are motivated by comparisons and competition and that only very limited feedback on waste sorting reaches the stores today. Two mockups of web visualizations were designed and presented to store managers and employees. The mockups elicited reactions from staff members in the stores indicating that economic feedback, poten-

tial savings, reachable goals and various pieces of advice in the mockups were appreciated. The mockups were designed to present not only current data but measurements and information that is *meaningful* to store managers and employees. However, there are still barriers hindering the transition to a more sustainable waste management regime, such as the conflict between economy and sustainability, the prioritization of waste management at a higher organizational level, and the complexity of donating food to NGOs. As this study only reveals the tip of the iceberg concerning obstacles to sustainable practices in grocery stores, we suggest that future research continues along this path. What kind of structural changes need to be undertaken to support staff in sustainable waste management? What can be done in the local store and what type of changes are needed in central management?

REFERENCES

[1]   The Ellen MacArthur Foundation, "Towards a circular economy - economic and business rationale for an accelerated transition," 2012.

[2]   R. Dirzo and P. H. Raven, "Global state of biodiversity and loss," *Annu. Rev. Environ. Resour.*, vol. 28, no. 1, pp. 137–167, 2003.

[3]   D. Tilman, K. G. Cassman, P. A. Matson, R. Naylor, and S. Polasky, "Agricultural sustainability and intensive production practices," *Nature*, vol. 418, no. 6898, pp. 671–677, 2002.

[4]   J. a Burney, S. J. Davis, and D. B. Lobell, "Greenhouse gas mitigation by agricultural intensification," *Pnas*, vol. 107, no. 26, pp. 12052–12057, 2010.

[5]   J. Norton, A. Raturi, B. Nardi, S. Prost, S. Mcdonald, D. Pargman, O. Bates, M. Normark, B. Tomlinson, N. Herbig, and L. Dombrowski, "A Grand Challenge for HCI: Food + Sustainability," *interactions*, New York, NY, USA, pp. 50–55, Nov-2017.

[6]   O. Chkanikova, M. Klintman, B. Kogg, M. Lehner, O. Mont, N. Nebelius, and A. Plepys, "Sustainability landscape of Swedish food retailers in the European context," 2013.

[7]   O. Chkanikova and O. Mont, "Overview of sustainability initiatives in European food retail sector," 2011.

[8]   Coop, "Coop Sverige Annual report 2016," 2017.

[9]   ICA Gruppen, "ICA Annual report 2016," 2017.

[10]   O. Chkanikova and O. Mont, "Corporate supply chain responsibility: drivers and barriers for sustainable food retailing," *Corp. Soc. Responsib. Environ. Manag.*, vol. 82, no. December 2012, pp. 65–82, 2012.

[11]   A. Thieme, R. Comber, J. Miebach, J. Weeden, N. Kraemer, S. Lawson, and P. Olivier, "We've bin watching you : designing for reflection and social persuasion to promote sustainable lifestyles," in *Proceedings of the 2012 ACM annual conference on Human Factors in Computing Systems - CHI '12*, 2012, no. January, p. 2337.

[12]   F. Altarriba, S. E. Lanzani, A. Torralba, and M. Funk, "The grumpy bin: reducing food waste through playful social interactions," in *Proceedings of the 2016 ACM Conference Companion Publication on Designing Interactive Systems - DIS '17 Companion*, 2017, pp. 90–94.

[13]   I. Reif, F. Alt, J. D. Hincapié Ramos, K. Poteriaykina, and J. Wagner, "Cleanly: trashducation urban system," in *Proceedings of the 28th of the international conference extended abstracts on Human factors in computing systems*, 2010, pp. 3511–3516.

[14]   H. Tan, L. Sun, and S. Sabanovic, "Feeling green: empathy affects perceptions of usefulness and intention to use a robotic recycling bin," in *25th IEEE International Symposium on Robot and Human Interactive Communication, RO-MAN 2016*, 2016, pp. 1051–1056.

[15]   P. Lessel, M. Altmeyer, and A. Krüger, "Analysis of recycling capabilities of individuals and crowds to encourage and educate people to separate their garbage playfully," in *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, 2015, pp. 1095–1104.

[16]   E. Ganglbauer, G. Fitzpatrick, and F. Guldenpfennig, "Why and what did we throw out?:

probing on reflection through the food waste diary," in *Proceedings of the ACM CHI'15 Conference on Human Factors in Computing Systems*, 2015, vol. 1, pp. 1105–1114.

[17]   R. Comber, E. Ganglbauer, J. H. Choi, J. Hoonhout, Y. Rogers, K. O'Hara, and J. Maitland, "Food and interaction design: designing for food in everyday life," in *CHI '12 Extended Abstracts on Human Factors in Computing Systems*, 2012, pp. 2767–2770.

[18]   A. Clear, R. Comber, A. Friday, E. Ganglbauer, M. Hazas, and Y. Rogers, "Green food technology: UbiComp opportunities for reducing the environmental impacts of food," in *Proceedings of the 2013 ACM conference on Pervasive and ubiquitous computing adjunct publication*, 2013, pp. 553–558.

[19]   M. Zlatow and A. Kelliher, "Increasing recycling behaviors through user-centered design," in *Proceedings of the 2007 conference on Designing for User eXperiences*, 2007, p. 27.

[20]   C. Frayling, *Research in art and design*. London: Royal College of Art, 1993.

[21]   W. Gaver, "What should we expect from research through design?," in *Proceedings of the 2012 ACM annual conference on Human Factors in Computing Systems - CHI '12*, 2012, p. 937.

[22]   A. Giorgi, *The descriptive phenomenological method in psychology: a modified Husserlian approach*. Pittsburgh, PA: Duquesne University Press, 2009.