8th International Conference on Mass Customization and Personalization – Community of Europe (MCP-CE 2018)
Digital Customer Experience
September 19-21, 2018, Novi Sad, Serbia

# INTEGRATING SUSTAINABILITY KNOWLEDGE IN CHOICE NAVIGATION

**Ottar Bakås, Børge Sjøbakk, Lars Skjelstad, Maria Thomassen**
SINTEF, Trondheim, Norway

**Abstract:** *A core capability of mass customization is to guide customers to their unique solution through proper choice navigation. There is a growing interest in society about how to make more sustainable choices. In this paper we explore the idea of integrating complex domain knowledge of sustainability effects of products data in the choice navigation process. The paper is based on action research with mass customizers in Norway. We present a single case study from a producer of recycling solutions. The concept of a waste analysis tool is used as a starting point for teaching the customer benefits of recycling, leading to a proposed product selection. The case study shows how environmental and economic benefits of the product can be integrated as part of the choice navigation process. Four key enables of sustainability choice navigation are discussed: trust through transparency, relatable communication, speed though simplification, and integrated knowledge sharing in product selection.*

**Key Words:** ***Mass Customization, Choice Navigation, Product Selection, Domain Knowledge, Sustainability, Environmental Benefits***

## 1. INTRODUCTION

Mass customization (MC) is a business strategy that addresses the challenge of meeting individual customer needs in a cost-efficient manner. It aims to combine the flexibility and personalization of custom-made products with the low costs associated with mass production [1].

*Choice navigation* has been identified as one of the three core capabilities in mass customization [2]. Choice navigation can be defined as the capability to "support customers in identifying their own solutions while minimizing complexity and the burden of choice" [2]. Choice navigation should support the customers to define their own solution within the solution space

Process satisfaction should be a key objective for choice navigation. In a study of 500 customization firms [3], three criteria were established to measure process satisfaction: usability, creativity and enjoyment. Additional criteria in the assessment included: uniqueness, choice options and visualization [3].

Online product configurators are often used as a tool for companies to convey their solution space to individual customers. Choice navigation applies at two levels of the customer's decision making:

1. *Product selection:* selecting the desired product or product family (choosing one among many)
2. *Product configuration*: customizing the selected product to individual needs (specifying across multiple variables to one individual solution)

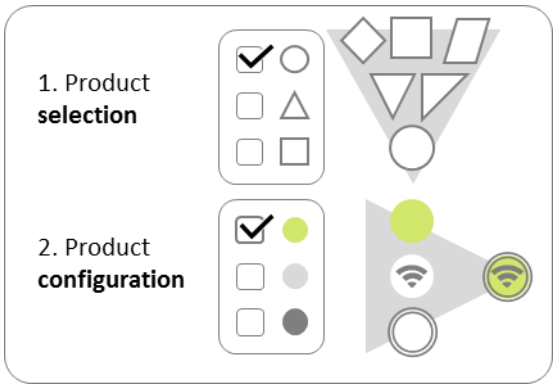


Fig. 1. *Illustration of product selection vs. product configuration*

Contemporary sales configurators today often cover both phases. And the application of configurators has spread to a wide range of industries. In the Configurator Database Report 2016 [4], over 1200 international web-based product configurators are identified. However, a significant amount of product configurator projects seems to fail. During one year, 204 (19 %) of the identified configurators from 2015 had disappeared [4]. Still, the momentum is growing, as 354 (34%) new configurators were included in the same study (ibid).

Even though the number of configurators are growing, there is little knowledge on the extent of how sustainability factors are applied in current choice navigation tools. Some previous studies have pointed to configurators as potentially having a positive impact on sustainability if environmental factors are included as selection criteria [5]. However, there are still few studies that address the the possible interrelations between mass customization efforts and green management [6] .

The purpose of this paper is twofold; First, we aim to investigate how the customer can be taught necessary domain knowledge through choice navigation techniques. Second, we explore the use of environmental factors as a part of choice navigation. More specifically, the paper provides insights into how

sustainability factors can be applied in choice navigation to teach the customer potential benefits of their specific choice as part of the product selection phase.

The remainder of the paper is structured as follows. First, some relevant previous work on choice navigation, configurators and sustainability issues are summarized. Then, the research context is described. This includes an introduction to the case company producing recycling waste bin systems. Then, we dive deeper into a specific tool that have been developed to teach customers about positive environmental and economic impacts as part of their choice navigation process. The discussion focuses on key learning points in terms of which choice navigation elements that can be observed in the case, as implications for other companies. Finally, the paper is concluded and limitations and future work is described.

## 2. . THEORETICAL BACKGROUND

### 2.1. Choice navigation

Two psychological concepts have been found important in designing choice navigation: the paradox of choice and the anticipated regret. The paradox of choice describes how "too many options can actually reduce customer value instead of increasing it" [2]. Giving customers too much choice creates information overload and a sense of paralysis instead of freedom. This can overburden the customer in his selection process. The decision-making process becomes a problem instead of a positive experience, and the buying decision might be postponed. Focusing on attribute preferences, as opposed to evaluating alternatives, have been found to increase satisfaction and learning [7].

The second concepts have be termed the anticipated regret of a choice [8]. The expectation of regret after the decision promote aversion to actually make the decision [8]. A sales configurator with a high level of focused navigation capability can help the customer limit the set of options to evaluate. More time can be spent to learn about the remaining options where preferences are less certain. Thus, a configurator with a focused navigation enable the customer to be more confident that the chosen solution is the best one [9]. This is in line with Forza and Salvador [10], calling for a simplification of the commercial model by limiting options.

The research from Salvador et al [2] identified three approaches to develop the capability of choice navigation. These three strategies can help a company mitigate the paradox of choice and anticipated regret of their customers:

1. *Assortment matching:* Software that matches the characteristics of an existing solutions space with the customer's needs and makes recommendations (e.g. Amazon).
2. *Fast-cycle, trial-and-error learning:* Software that help customers define their needs and interactively test and visualize the match (example: NIKEiD custom shoes).
3. *Embedded configuration:* Products that "understand" how they should adapt to the customer and then reconfigure themselves (e.g.: Tesla adapting to different drivers)

### 2.2. Environmental factors in choice navigation

Research on how mass customization business models impacts the environment is still scarce, but the topic receiving increased attention [6]. Some studies focus on the benefit of waste reduction based on replacing forecast-based mass production with a configure-to-order system with no finished goods inventory [11] [12]. Other studies consider how enablers of MC, such as product modularity and postponement, impacts environmental performance [5] [13]. Both positive and negative effects have been described, depending on the specific type of product [12].

Trentin et al. [6] studied organizational capabilities for mass customization and green management. The identified the capability of '*greening the customer'*, defined as "the capacity to advise, […], educate and support in the environmentally sound use, transportation, storage and disposal of products". It is proposed that the cost of developing a capability for 'greening the customer decreases as the capability of parts commonalization increases. A survey of 238 plants in Europe, Asia and America showed how the positive effect of product stewardship capability on environmental performance increases as parts commonalization capability increases. [14].

Pourabdollahian et al. [11] studied mass customization from a product life-cycle perspective and identified factors that influence the environment both positively and negatively. In the design phase, they found that involving customers in a *co-design and specification process* enable products that are more aligned with customer's requirements compared to standardized offerings. This enables companies to produce only those products that is needed by the customers [11]. The amount of waste can hence be decreased, as this reduce the risk of obsolete make-to-stock products.

The work of Hora et al. [15] describes a framework for sustainable mass customization based business models. One of the seven key elements in this business model is '*sustainable configuration'*. This is described as means "to incorporate environmentally and/or socially conscious choices in the user-interface". This involves informing customers about the sustainability impacts of their choices.

The configurator tool itself can act as an impact factor for increased sustainability decision making. Configuration of a mass customized product allows the customer to define his or her unique solution by choosing among factors of fit (size, measurements), form (design, colours) and function (performance attributes). If such configuration choices are extended by giving information about potential environmental impacts of each selected feature and the total sustainability impact the final product configuration, customers can make more environmentally friendly choices [5].

This is in line with Bardurdeen and Lyanage [16] which call for product configurators to offer an

evaluation of any desired configuration with respect to environmental and social performance.

An example of this type of sustainability choice parameters can be seen from Kinnarps, one of Europe's largest manufacturers of office furniture. In 2015, they launched their own index of sustainability called "The Better Effect". It is currently introduced in their configurator for office furniture, chairs, etc. The index contains five areas where each product gets a score from 0 (worst) to 3 (best). These five areas are raw materials and resources, climate, pure materials, social responsibility, re-use, and ergonomics (see Fig. 2).

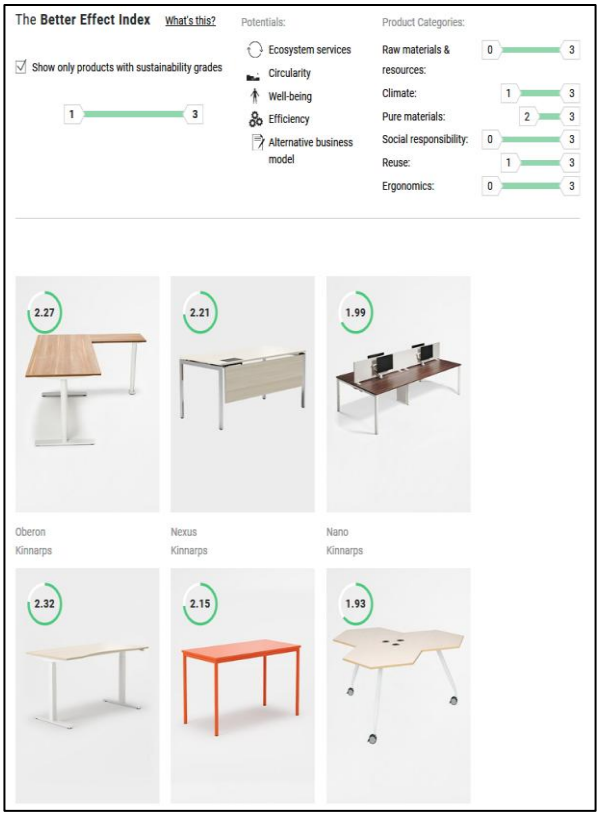


Fig. 2. *Choice navigation from Kinnarps (2018) including the Better Effect Index*

The product selector allows the user to narrow down its solution space by using sliders that reduce the available products. Specific requirements can be set of each of the five categories, meaning that the customer for example can limit its choice to desks that have a score of 2 or better in pure materials, but without restrictions in the score for ergonomics.

In addition, each product is rated in terms of its positive potential within five areas of available ecosystem services, possibility for circular material flows, contribution to well-being and healthy working environments, allowing for efficiency of work space usage, and if it allows for alternative business models other than ownership.

Practical cases like these, where specific sustainability information is introduced in the choice navigation process, are emerging, but still scare. What elements are important when trying to teach the customer this type of complex environmental issues in a user-friendly manner? We will continue to explore this issue through a practical case, after a brief introduction about the research context.

## 3. RESEARCH METHOD

The empirical data have been collected through a case study of a Norwegian manufacturer that have worked actively with mass customization over several years; lately through the joint research project CustomR, funded by the Research Council of Norway.

The Custom$^{R}$ project is founded in action research as methodological framework. Researchers and the problem holder (in this case the Norwegian SME) collaborate in solving real life problems. New knowledge is acquired for both parties and fed back to the body of knowledge within research [17]. In this project, four companies collaborate to strengthen their abilities within mass customization and choice navigation. Each of the four companies are delivering though agents and distributors and have limited direct contact with end users. At the same time, all four companies deliver products where their customers need to have significant domain knowledge to co-create solutions and make their best choice. This poses a specific and common challenge in the way they need to approach choice navigation, as they need to convey complex domain knowledge without over-complicating issues for the user. All four companies are currently working on developing web-based choice navigation as part of the research project.

This specific paper shows a case study from Company Alpha. They deliver recycling solutions and needs to communicate knowledge about waste management. Company Alpha have now decided to test how they can enhance the customers understanding of sustainability benefits of their solution. They have implemented a recycling calculator tool as a choice navigation assistant. The tool and its functionality is described in following chapter 4.2.

In this paper, a single case study approach is taken, as to study in detain an illustrative key case, allowing for describing an emerging issue in depth. Company Alpha was selected due to its ambition to develop a novel choice navigation tools that cover both the product selection and product configuration case. Further, Company Alpha delivers recycling solutions that were deemed to have substantial environmental impact over the usage phase of the products.

The case data have been gathered from a series of workshops, semi-structured interviews, historical sales data and observations at the company over a period of 12 months.

## 4. RESULTS

### 4.1. Case Company Alpha

The case company is a Norwegian manufacturer of metal products. Their two main product groups are recycling systems and hotel cleaning trolleys. However, they also produce a wide range of other products based on customer demand. They customize products based to order and work closely with customers throughout the process from concept and design to delivered product.

They work actively with external designers and their customer base to develop new products based on emerging needs in the market. Key case characteristics are given below in Table 1.

Table 1. *Overview of Case Company Alpha*

| Company | Alpha |
|---|---|
| Founded | 2008 |
| No. employees | 30 |
| Turnover '16 | 32 549' NOK (ca 3,4 Mill Euro) |
| Products | Waste handling & cleaning |
| Solution space | Thousands (full NCS/ RAL colour range) |
| Demand and production characteristics | Mix of make-to-order (projects) and some make-to-stock (predictable demand), mostly smaller batch production |
| Product variety determinants | Model type, colour/ design, waste bin labelling |
| Primary sales channel | Dealers with purchasers for large scale projects |
| Important stakeholders | (Interior) architects, building owners (e.g. airports, schools) |
| Product variety determinants | Model type, colour, waste bin labelling. |
| Main improvement focus last years | Production planning and control, automation |
| Main challenge/ future focus | Choice navigation, product smartness, visualization of goods and information flows. |

Case company Alpha have now decided to test how they can enhance the customers understanding of sustainability benefits of their solution. They have implemented a recycling calculator tool as a choice navigation assistant. The tool and its functionality is described in the following chapter.

### 4.2. Developed recycling calculator tool

The purpose of the recycling calculator tool is to help the customer understand the benefits of investing in a proper recycling system in public spaces or office environments. More specifically, the aim is to present the customer with specific potential savings in economic and environmental terms. The calculator estimates a yearly savings potential from reducing the amount of residual waste. Further, the tool provides estimates of environmental benefits of yearly saved in CO2 equivalents, based on recycling materials such as plastics, paper, glass, metal etc.

The primary target audience for the tools are specified to be purchasing managers, building managers, and sales personnel at distributors and dealers. Further, other stakeholder roles are identified as relevant, including internal sales personnel at the case company, environmental managers, property managers, as well as architects and interior designers.

The ambition was to find a way to convey to these user groups how the recycling station solutions would benefit the customers in terms of a triple bottom line (See Fig. 3). Increased recycling of materials has a positive impact on reducing CO2 emissions [18]. Further, customers should learn how introducing recycling schemes at the office can reduce the amount of residual waste significantly. Residual waste is often costly to dispose of, whereas other materials collected for recycling is delivered at a much lower cost, and even for free. Further, the case company wanted to present the positive benefits of improved waste management for people in public spaces, contributing to clean, clear and secure surroundings.

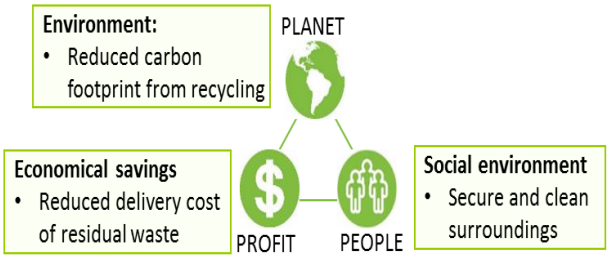


Fig. 3. *Triple bottom line purpose of the recycling calculator tool.*

In the following paragraphs, the details of the recycling calculator tool are presented.

#### *4.2.1 Step 1 and 2: Building user data*

The user is asked to identify the correct type of building according to four categories: education, office, industrial or public space. Information about size of the building was chosen to be set in categories, varying with the type of building that is selected.

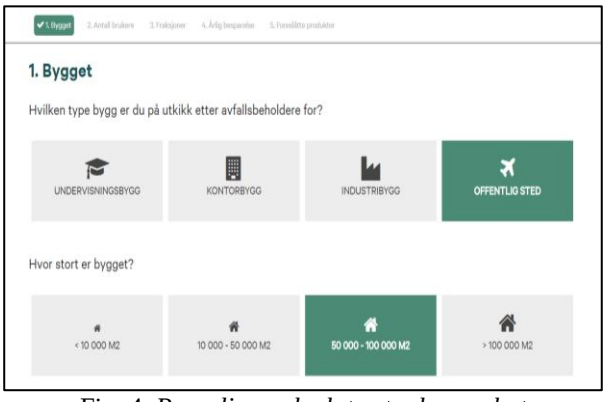


Fig. 4. *Recycling calculator tool snapshot*

An important dimensioning factor for analysing recycling needs will be to know the number of users for the building. Four predefined intervals are chosen to accommodate different sizes of premises that are typical clients of the recycling systems, such as office buildings, hotels, universities and airports.

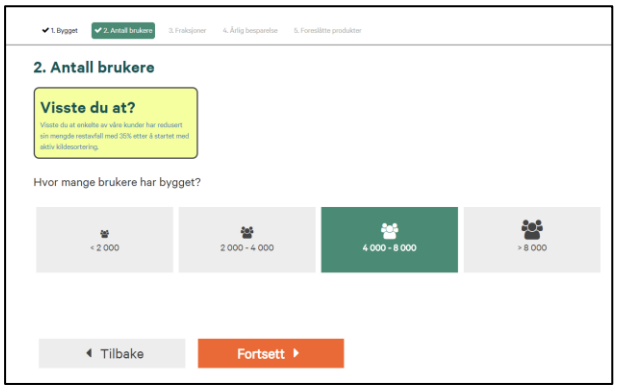


Fig. 5. *Recycling calculator tool snapshot*

### 4.2.2 *Step 3: Recycling needs*

In the third step, the different types of sorting materials are chosen. Analysis of recent sales data shows that most customers choose to buy four main recycling types: residual waste, paper, bottles and plastics. These four types are pre-selected to aid the customer, but the he can choose freely among the twelve available categories.


Fig. 6. *Recycling calculator tool snapshot*

Also note the tip-box for the customer in yellow. It reads: "Did you now that: all our recycling bins can be upgraded with additional integrated sorting bins at a later stage". This type of information is intended to aid the user to overcome the sense of "anticipated regret", reassuring that it is easy to alter the configuration of the sorting bins at a later stage after purchase and installation.

### 4.2.3 *Step 4: Yearly savings*

Step 4 shows an estimate of financial and environmental savings from increased recycling (See Fig. 7). The economical savings estimate is based on a calculation of reducing the residual waste. The calculation takes into account the estimated amount of waste generated by that type of building (school, office airport etc) and number of users, as well as the recirculation rate that is typically received based on their number of sorting stations.

It shows economical savings in one year and in a ten years perspective, allowing for life cycle considerations of the investment.

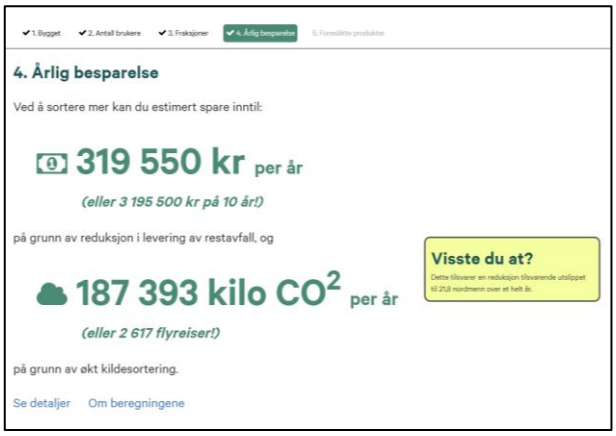


Fig. 7. *Recycling calculator tool snapshot*

The environmental savings estimate is based on data from a Nordic study of the climate benefits of materials recycling. In this report, the specific CO2 benefits from recycling materials such as glass, paper and plastics are calculated using life-cycle analysis methodologies [18]. The number of kg CO2 equivalents is an abstract number that is hard for many people to relate to. Therefore, the number is also translated to two other and more tangible figures: the equivalent of CO2 foot print of air travel for one person travelling from Oslo to Trondheim and compared to the total usage of CO2 per person in Norway.

The user is also able to see the details of their calculation, allowing for a better understanding of the underpinning factors contributing to the total calculation (see Fig. 8).


Fig. 8. *Recycling calculator tool snapshot*

In addition, all the source materials used to do the calculations are described and references are given to the sources, so that interested users can learn more about the original source data (Fig 9).

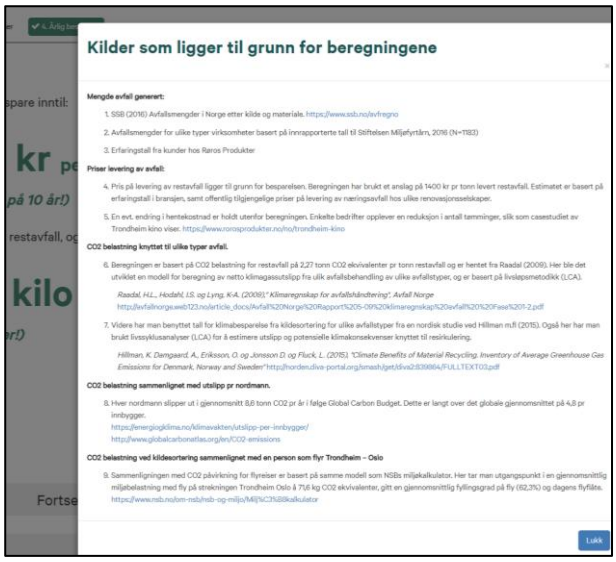


Fig. 9. *Recycling calculator tool snapshot*

*4.2.4 Step 5: Suggested products*

The last step of the product calculator presents a suggestion of three product families that are estimated to fit the user.

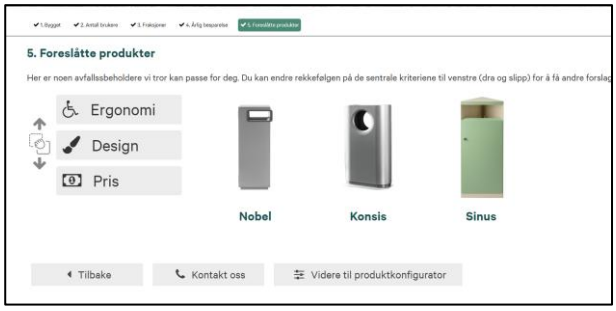


Fig. 10. *Recycling calculator tool snapshot*

A drag-and-drop menu allows the user to prioritize among three typical functional criteria for recycling systems: ergonomics, design and price. By rearranging these three criteria, the top three highlighted products re-arrange, based on a product attribute matrix.

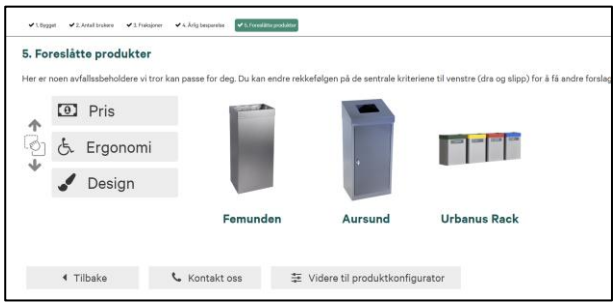


Fig. 11. *Recycling calculator tool snapshot*

After the user selects a product, he or she can move further to configurating this specific product family to fit customer needs of sizes, colours, station arrangement, labelling etc.

## 5. DISCUSSION

This section aims to discuss the specific choice navigation design elements that can be identified in the recycling calculator tool of Company Alpha. The purpose is to identify elements that can prove beneficial for other companies that aim to convey their message on sustainability though choice navigation.

### 5.1. Building trust through transparency

Trying to teach the customer about product benefits can best be achieved when the customer trusts your information. In this tool, trust is being built through transparency. The recycling calculator tools is showing the user the details of the calculations, so that the estimates can be further understood by the customer. Trust is also being built by showing the sources of the calculations. Credible sources are also used, such as the official Norwegian statistics agency, The Nordic Council of Ministers reports and environmental foundations.

The importance of using reliable data is supported by Hänsch et al [19], focusing on the active role that the customers take in a co-creation process. Trusting the source of information therefore becomes imperative.

### 5.2. Comparing to what customers can relate to

A ton of CO2 equivalents is an abstract measure for most of us. It only gives meaning if the number can be related to a known quantity. Therefore, the recycling calculator tool is translating the CO2 measures to more easily understandable sizes. For example, it compares the potential CO2 savings of the recycling system with number of air travels.

This is in line with Hänsch et al [19], stating that information on environmental impacts can often be difficult to relate to daily life experience. They propose taking a value-based approach, for example by comparing the environmental effects of a TV in a life-cycle perspective to amount of kilometres driven by a car. They state that the customers buying preferences can be influenced or "nudged" toward a more sustainable consumption.

### 5.3. Speed and simplification

Online users are in a rush. Therefore, a set of design choices were made for the recycling calculator tool to speed up the process. Instead of asking the customer to define exactly the number of square meters, predefined intervals have been used. This reduces the accuracy of the calculations, but gaining speed was deemed more important than accuracy, as these will only be estimates.

The calculator has also made certain limitations in the estimate of economical savings. For instance, potential changes in cost of transportation have been held outside the calculation, even though many companies experience a reduced need of waste transportation after increasing their recycling efforts.

### 5.4. Sharing knowledge throughout the process

Recycling and sustainability are complex issues. Case Company Alpha has significant knowledge about the domain that can benefit the users. Snippets of this

knowledge is shared with the customer through "Did you know that …" boxes throughout the navigation process. Customer that are particularly interested in a topic can click this box and learn more about the issue.

## 6. CONCLUSION

The purpose of this paper has been to gain greater insight into how choice navigation practices evolve in the era of greater concern for sustainable solutions, both from a customer and a company perspective. More specifically, the paper has shown a specific case of how long term economic and environmental benefits can be highlighted through a product selection tool called a recycling calculator. Four main aspects of the choice navigation solution were found in this case:

- Establishing trust through transparency and
- Comparing abstract numbers to practical issues the customer can relate to
- Designing for speed through the choice navigation process through simplification
- Sharing samples of domain knowledge through the navigation process

*Limitations.* This paper is based on a single case study, having its drawbacks of limited ground for generalization. Further, the authors of the paper have been actively involved in the concept development of the recycling calculator tool, influencing objectivity of the research. However, the research strategy of action research provides the benefits of mutual learning between practitioners and researchers and have provided the access to a highly interesting case with future potential.

The main sustainability effects that are presented in this paper is based on the specific product of the case company – the recycling station solutions. Therefore, not all aspects of this case can be easily transferred to other cases. However, the paper aims to show how specific product benefits can be communicated efficiently to the customer, and therefore motivate the customer to make a well-informed choice about what effects a purchasing decision can have on economic and environmental performance.

*Future work.* The recycling calculator tool now moves into a phase of more in-depth market testing with real customers. It will be interesting to see if the level of detail of how calculations are presented are deemed to be at the right level.

Also, the calculator will be integrated with the product configurator that is under development in the case company. It will be interesting to study how the integration between product selection and configuration can best be achieved.

There is a need for raising awareness of sustainability of our choices as customers and as a society. The integration of environmental, economical and social impacts of our products and services will become increasingly important as we move towards a greener future.

## 7. ACKNOWLEDGEMENTS

This research is part of the CustomR research project (256634), supported by the Research Council of Norway. The authors would like to thank the project participants for providing valuable empirical data and discussions.

## 8. REFERENCES

[1] B.J. Pine, *Mass customization: the new frontier in business competition*. Brighton, MA, USA: Harvard Business Press, 1999.

[2] F. Salvador, P.M. De Holan, and F.T. Piller, "Cracking the code of mass customization", *MIT Sloan management review*, vol. 50, no. 3, 2009, p. 71-78.

[3] D. Walcher and F.T. Piller, *The customization 500: an international benchmark study on mass customization and personalization in consumer e-commerce*. 2012, Lulu.com.

[4] P. Blazek, M. Partl, and Streinchsbier, *Configurator Database Report 2016*. Vienna: Cylines Collection, 2016.

[5] F. Badurdeen and J. Liyanage, "Sustainable value co-creation through mass customisation: a framework", *International Journal of Sustainable Manufacturing*, vol. 2, no. 2-3, 2011, p. 180-203.

[6] A. Trentin, C. Forza, and E. Perin, "Embeddedness and path dependence of organizational capabilities for mass customization and green management: A longitudinal case study in the machinery industry", *International Journal of Production Economics*, vol. 169, no. 169, 2015, p. 253-276.

[7] C. Huffman and B.E. Kahn, "Variety for sale: Mass customization or mass confusion?", *Journal of Retailing*, vol. 74, no. 4, 1998, p. 491-513.

[8] M. Zeelenberg, "Anticipated regret, expected feedback and behavioral decision making", *Journal of Behavioral Decision Making*, vol. 12, no. 2, 1999, p. 93-106.

[9] A. Trentin, E. Perin, and C. Forza, "Increasing the consumer-perceived benefits of a mass-customization experience through sales-configurator capabilities", *Computers in Industry*, vol. 65, no. 4, 2014, p. 693-705.

[10] C. Forza and F. Salvador, *Product information management for mass customization*. New York: Palgrave Macmillan, 2007.

[11] G. Pourabdollahian, et al., "A contribution toward a Research Agenda: Identifying Impact Factors of Mass Customization on Environmental Sustainability", *International Journal of Industrial Engineering and Management*, vol. 5, no. 4, 2014, p. 169-178.

[12] T.D. Petersen, et al., *Is mass customization sustainable?* , in *MCPC 2011 Conference on Mass Customization, Personalization, and Co-Creation*, H. Chesbrough, F.T. Piller, and M. Tseng, Editors. 2011: San Francisco, CA. p. 8.

[13] K. Nielsen, et al., *Supporting sustainability and personalization with product architecture* in *MCPC 2011 Conference on Mass Customization, Personalization, and Co-Creation*, H. Chesbrough,

F.T. Piller, and M. Tseng, Editors. 2011: San Francisco, CA. p. 16–19.
[14] E. Sandrin, A. Trentin, and C. Forza, *Mass Customization and Environmental Sustainability: A Large-Scale Empirical Study*, in *Customization 4.0.*, S. Hankammer, et al., Editors. 2018, Springer: Cham, Switzerland.
[15] M. Hora, et al., "Designing Business Models for Sustainable Mass Customization: A Framework Proposal", *International Journal of Industrial Engineering and Management*, vol. 7, no. 4, 2016, p. 143-152.
[16] F. Bardurdeen and J. Liyanage, "Sustainable value co-creation through mass customization: a framework", *International Journal of Sustainable Manufacturing* vol. 2, no. 2-3, 2011, p. 180-203.
[17] D.J. Greenwood and M. Levin, *Introduction to Action Research: social research for social change*. 2nd ed., Thousand Oaks: Sage Publications, 2007.
[18] K. Hillman, et al., *Climate Benefits of Material Recycling*. 2015, Nordic Council of Ministers: Denmark. p. 87.
[19] A. Hänsch, et al., *A preparatory Approach to Environmental Assessment for Sustainable Mass Customization*, in *Customization 4.0*, S. Hankammer, et al., Editors. 2018, Springer: Cham, Switzerland. p. 315-337.

**CORRESPONDENCE**

Ottar Bakås
SINTEF
S. P. Andersens veg 5
7465 Trondheim, Norway
ottar.bakas@sintef.no

Børge Sjøbakk
SINTEF
S. P. Andersens veg 5
7465 Trondheim, Norway
borge.sjobakk@sintef.no

Lars Skjelstad
SINTEF
S. P. Andersens veg 5
7465 Trondheim, Norway
lars.skjelstad@sintef.no

Maria K. Thomassen
SINTEF
Forskningsveien 1
0373 Oslo, Norway
maria.thomassen@sintef.no