

# A Toolkit for Designing Products and Services Fit for Circular Consumption

Oskar Rexfelt, Anneli Selvefors

Department of Industrial and Materials Science, Division Design & Human Factors,  
Chalmers University of Technology, Gothenburg, Sweden

## Abstract

This paper introduces *the Use2Use design toolkit* – a set of tools that can be used to design for circular consumption. In contrast to other available circular design tools, the toolkit emphasises the importance of applying a user perspective when exploring opportunities for product circularity. It aids designers and other agents to explore user needs, identify consumption-related design challenges, and design products and services that can create enabling preconditions that make it possible, more convenient, and preferable for people to circulate products from use to use. The process to develop the tool is initially presented followed by a description of the toolkit and its five tools. The paper concludes with a discussion regarding how the proposed toolkit compares to other circular design tools and what implications it has for design practice and future research.

## Keywords:

Circular design tool, toolkit, user centered design, circular consumption, circular economy

## 1 INTRODUCTION

Recent literature on design and the circular economy has highlighted the crucial role design plays for a transition to a circular economy. It is often suggested that the transition requires products that are designed to last long, are fit for circular (re-) production flows, and are offered through circular services (see e.g. [1][2]). During the last couple of years, several circular design tools have been released aimed to support the exploration of such design opportunities. For instance, tools such as The Circular Design Guide [3], The Circular Economy Toolkit [4], Business as Unusual [5], a tool for assessing remanufacturing from the customers' perspective [6] and the Circular Pathfinder [7] offers worksheets and/or online platforms that can aid designers to explore different types of design opportunities.

A common denominator amongst these and other proposed tools is that they primarily focus on design opportunities related to production processes and/or business models. While such opportunities are essential to address to bring about a transition to a circular economy, opportunities to support changes in consumption are equally important [8][9]. A transition to a circular economy is dependent on that people shift from linear consumption processes (i.e. buying new products, using, and disposing of them as trash) to circular consumption processes (i.e. obtaining pre-used products, using, and passing them on to others). Circular consumption (such as renting, borrowing or buying second hand) often requires new activities and entails different practicalities compared to linear consumption, which may sometimes make people refrain from obtaining pre-used

products or passing them on [10]. Hence, if aiming to support changes in consumption through design it is crucial to gain an in depth understanding of people's consumption processes and what they entail for everyday life.

Although available circular design tools either implicitly or explicitly take (some) aspects related to consumption into consideration, such as circularity-related behaviours and factors influencing acceptance of circular offers [11], they do not sufficiently address the changes in activities and practicalities that circular consumption often entails. Instead of highlighting the crucial role people play for product circularity, available tools often merely consider people as recipients of circular offers that should adopt circular behaviours. As a consequence, important design opportunities to support circular consumption, such as designing products that make it easy for people to inspect, value, or disassemble a product, are often overlooked [10].

The aim of this paper is to introduce a new circular design toolkit that have been developed to especially address people's consumption processes and the design challenges they entail. Following a brief method overview, the toolkit and included tools will be presented and the contribution as well as implications for design practice and future work will be discussed.

## 2 METHOD

The toolkit proposed in this paper is the result of an explorative and iterative process that began in 2013. The process was initiated with an explorative workshop in which seven researchers in the fields of user-centred design



Fig. 1: Early versions of the proposed tools used during workshops with companies

and sustainable design explored how product circularity could be framed with the user taking centre stage. Already existing and common representations of product circularity were examined in order to obtain an understanding of how users were represented in these, and to confirm the need for a new representation. A new user-centred perspective on product circularity, *the Use2Use-perspective*, was then developed during the following years. For a detailed description see [10][12].

In 2016, the work to embody this perspective into a design toolkit was initiated. First, different potentially valuable tool components, covering e.g. analysis of use and ideation support, were developed. These early versions of the tools were used as a basis for exploring what content that would be valuable to designers and other relevant agents.

The initial tools, as well as their subsequent iterations, see Fig. 1, have been explored and evaluated through three main research activities during 2016-2019. First, workshops were conducted during 2016 and 2017 with designers, product developers and product managers from six companies (in total four workshops, each with 6-8 company representatives) to verify the need for the toolkit and to identify the requirements on it. The workshops were arranged in collaboration with the Swedish companies Transformator Design and Hultafors Group. The participants were asked to explore circular consumption design opportunities related to their product and service offers aided by early versions of the tools. The generated ideas and the participants' experiences of using the tools were discussed afterwards, both by the participants and the workshop organisers, and also analysed by the research team.

Second, refined versions of the tools were tested in workshops with design students in courses on Sustainable Design at Chalmers University of Technology (altogether on six occasions during 2017-2019, each with circa 30 students). The tasks were to gain an understanding of what circular consumption entail for people and come up with innovative ideas to make circular consumption preferable. The generated ideas and the tools' potential to support idea

generation in comparison to another tool which the students had previously used, the Ecodesign strategy wheel [13], were discussed afterwards.

Third, refined versions of the tools were also tested by design students in their master thesis projects (in total by 13 students in seven teams) to identify design opportunities and suggest design concepts. The thesis projects concerned the design of a mobile application for sharing [14], a digital platform for sharing assets within the culture sector [15], an autonomous delivery droid for collaborative consumption [16], a tent for a rental service [17], a sofa for a furniture subscription service [18], earphones for a rental service [19], and cars for a sharing service [20]. The experiences of the thesis students were monitored throughout their projects and all students were interviewed retrospectively to gain insight into their use of the tools and the challenges and implications they had experienced.

Through these activities, insights regarding the tools' potential value and usability were gained from both academia and industry and opportunities to improve the tools were identified. The tools were adjusted accordingly and packaged into the toolkit proposed in this paper.

### 3 THE USE2USE TOOLKIT

The toolkit includes five mind-expanding packs designed to boost product circularity by aiding the development of products and services fit for circular consumption processes. The five included tools address the early phases of a user-centred design process and together they cover elicitation of user needs, specification of design challenges, concept generation and evaluation. The tools can be used consecutively but also independently of each other. As illustrated in Fig. 1, the five tools differ in a number of ways, e.g. in regard to their purpose, format, and expected outcome. The toolkit is freely available at [www.use2use.se](http://www.use2use.se) (from September 2019). The tools and their intended use are presented in section 3.1-3.5






	 <b>USE2USE THINKING ACTIVATION PACK</b>	 <b>CIRCULAR JOURNEYS EXPLORATION PACK</b>	 <b>MULTIPLE USE-CYCLES EXPLORATION PACK</b>	 <b>CIRCULAR DESIGNS IDEATION PACK</b>	 <b>CIRCULAR DESIGNS EVALUATION PACK</b>
<b>PURPOSE</b>	To accentuate circular consumption and related design opportunities	To aid companies to chart user activities and experiences during circular consumption processes	To aid companies to empathise with subsequent users and understand how their needs vary	To aid companies to envision products and services that enable circular consumption	To aid companies to assess circular product and service concepts
<b>FORMAT</b>	Learning and discussion activities, supported by educative cards	Analytic workshop, supported by a set of journey mapping pieces	Relay exercise, supported by empathisation cards	Creative workshop, supported by design strategy cards	Analytic discussion, supported by screening canvases
<b>SUGGESTED PARTICIPANTS</b>	Anyone, especially designers, strategists, managers, and policy makers	Designers, user researchers, product managers, and users	Designers, user researchers, product managers, product developers, and users	Designers, user researchers, product managers, and product developers	Designers, strategists, business developers, managers, and sustainability experts
<b>NUMBER OF PARTICIPANTS</b>	1-n people, depending on the type of activity	2-6 people	4-8 people	2-6 people	2-6 people
<b>TIME REQUIRED</b>	20-60 min, depending on format	1-3 hours	30-60 min	30 min - 2 hours	30-60 min
<b>PREPARATIONS REQUIRED</b>	-	User insights, and a flat surface min 1x2m <sup>2</sup>	User insights, and a product or a representation of it	Identified consumption-related design challenges, and workshop material	Documented concept(s) to assess, and insight into preconditions for implementation
<b>EXPECTED OUTCOME(S)</b>	Optional: documented insights and user related design challenges	Documented insights and user related design challenges	Documented insights and user related design challenges	Documented design concept(s) and key benefits	Identified design concept(s) worthy of further development

Fig. 2: Overview of the five tools included in the Use2Use design toolkit

### 3.1 Use2Use thinking activation pack

The purpose of the *Use2Use thinking activation pack* is to help designers and other relevant agents to focus on circular consumption and related design opportunities. In particular, it is intended to convey a user perspective on product circularity, to complement the often prevalent production and business model perspective.

As can be seen in Fig. 3, the tool consists of a set of educational cards that each underline an important aspect related to the users' role in product circularity. All cards

have a statement on the front side, e.g. "People don't care about business models", to spark curiosity. The quotes are elaborated upon on the cards' back sides, which present information regarding the topic of the quote. Each card can stimulate discussion and provide insights to the participants, but it does not emphasise any specific output besides this. Neither is there any specific procedure suggested for using this tool; the cards can be used in the way that they are believed to be most useful for the situation at hand, e.g. seminars, meetings, workshops etc.

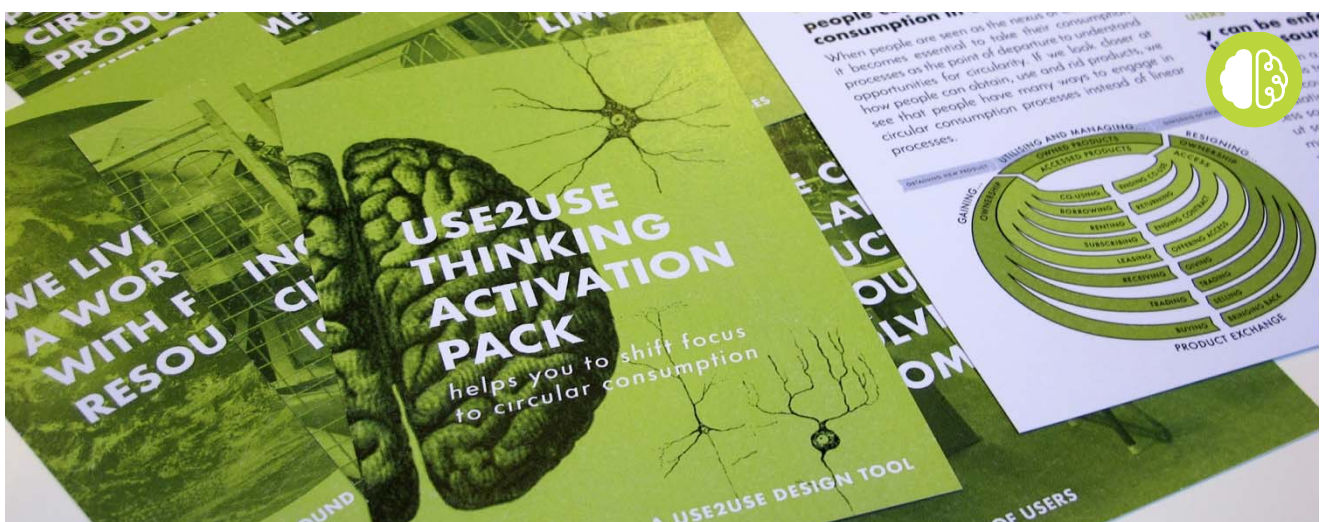


Fig. 3: The Use2Use thinking activation pack consists of a set of educational cards

### 3.2 Circular journeys exploration pack

The *Circular journeys exploration pack* helps designers and other agents to chart user activities and experiences during circular consumption processes. It is intended to be carried out as an analytic workshop, where the participants use pre-defined pieces to map out consumption processes on a flat surface such as a table, see Fig. 4. It is possible to map out journeys that have been thoroughly researched through user studies, but also less explored journeys based on for instance the participants' own experiences. Future consumption processes can also be mapped using the tool, making it possible to 'prototype' potential circular consumption journeys.

The pack contains pre-defined pieces of different kinds. The most central pieces are the hexagonal activity cards, which constitute the backbone of every mapped consumption journey. These pieces describe the main consumption activities such as "Explore obtainment opportunities", "Initiate product use" and "Prepare product for riddance". These pieces are specifically designed to cover the three main phases of consumption: obtainment, use and riddance. The pack also contains pieces to detail how these activities are carried out, and pieces to highlight important decisions for the user. In addition, there are pieces to indicate experiences that are typically considered negative or positive by the users.

By mapping circular consumptions journeys, user activities and everyday practicalities can be explored. Gaining an understanding of these aspects is key if one wants to improve consumer experiences related to circular consumption.



Fig. 4: The Circular journeys exploration pack consists of pre-defined pieces that can be used to chart people's consumption journeys

### 3.3 Multiple use-cycles exploration pack

The *Multiple use-cycles exploration pack* helps designers and other relevant agents to empathize with subsequent users and understand how their needs vary. "Subsequent users" refers to the fact that product circularity entails that product are circulated from user to user, something that other circular design tools and methods typically do not emphasise.

As shown in Fig. 5, the tool consists of a set of empathisation cards that each underline an important aspect that should be considered for products that are to be used by a sequence of users. Every card has a quote, e.g. "I have just obtained the product from the previous user. I'm worried that parts of the product or its accessories are missing". The quote is followed by a number of questions to trigger discussion regarding the topic of the quote, and to support the identification of related design challenges.

The cards are intended to be used during an exercise in the form of a relay. A product to base the discussion on is first defined, and this product is then handed over between participants (preferably physically if the product is present and is small enough). Each time the product is handed over, the 'new user' draws a card and the topic of the card is discussed in relation to the product.

This tool can help identify problems and concerns related to sequences of users. In addition, it can unveil how certain activities that are carried out often during circular consumption processes make it important to re-prioritise the product requirements. For instance, a requirement that a product should be intuitive to use becomes even more important if the product is to be used by a new inexperienced user every day.

### 3.4 Circular designs ideation pack

The *Circular designs ideation pack* helps designers and other relevant actors to envision products and services that enable circular consumption. The tool comprises design strategy cards for four areas related to circular consumption: "Extended use", "Product exchange", "Circular match-making", and "Multiple use-cycles" (for a more detailed description of these design strategies see [10]). Each design strategy is described on a large card, which also contains trigger questions related to the strategy. The other side of the card shows an inspiring design example, i.e. a product or service in which the design strategy has been successfully incorporated. Fig. 6 provides examples of some of the strategy cards.

The purpose of this tool is to spark ideas. It will help if the explorative tools (*the Circular journeys exploration pack* and *the Multiple use-cycles exploration pack*) have been used beforehand, so that one is aware of what consumption-related design challenges to focus on. It is however not necessary, since each card has a short introduction describing typical design challenges.



Fig. 5: The Multiple use-cycles exploration pack consists of a set of cards that each underline an important aspect that should be considered for products that are to be used by a sequence of users



Fig. 6: The Circular designs ideation pack consists of a set of design strategy cards

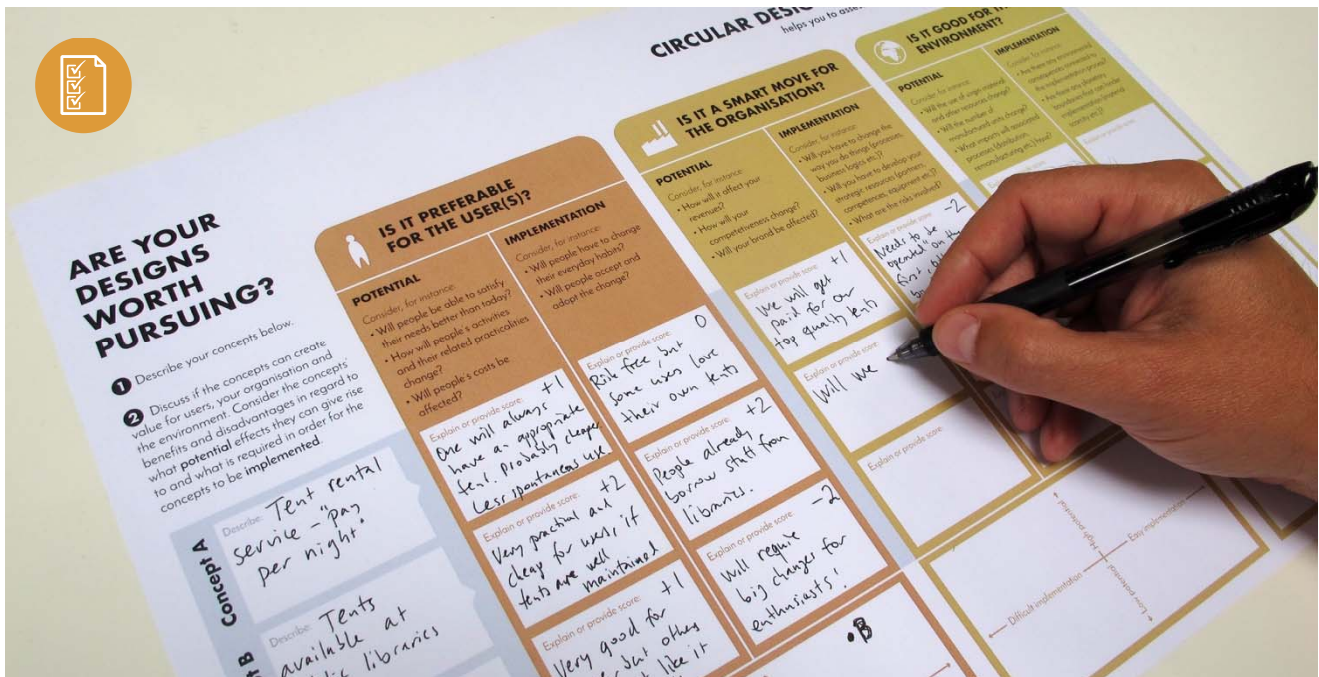


Fig. 7: The Circular designs evaluation pack consists of a canvas with an assessment matrix

### 3.5 Circular designs evaluation pack

The *Circular designs evaluation pack* helps designers assess circular product and service concepts. Each concept is evaluated from the point of view of three different stakeholders: the Users, the Organisation (e.g. a company) and the Environment. For each of the stakeholders, two aspects are evaluated. The first one is “potential”, referring to the effects the concept will have for the stakeholders if it is implemented. The other aspect is “implementation”, which refers to what is needed to successfully implement the concept.

As shown in Fig. 7, the tool consists of an A3-format canvas with a large matrix, in many ways similar to a Pugh-matrix [21]. To aid assessment of the concepts from each stakeholder’s point of view, supportive questions are included on the canvas. The canvas also has a section to mark all the concepts on a chart similar to a PICK-chart [22], often referred to as an impact-effort matrix. This way, all concepts can be compared regarding their potential effects, and the effort needed in the implementation process.

## 4 DISCUSSION

The overall contribution of the proposed *Use2Use design toolkit* and its implications for design practice and future work will be discussed in this section.

### 4.1 Contribution

Since the toolkit has been developed to especially address people’s consumption processes and the design challenges they entail, it complements previously proposed circular

design tools in several ways. It is designed to aid the exploration of user needs and, as recommended by [10], it provides support for conducting new types of user studies. Two of the tools, *the Circular journeys exploration pack* and *the Multiple use-cycles exploration pack*, can be used together with users to facilitate user needs elicitation. Through the use of these tools it will be possible to identify design challenges and product requirements that are essential to address in order for circular consumption processes to become more preferable compared to linear ones. For instance, although “facilitate cleaning” is an important requirement for most designs, it becomes even more relevant if a product is to be used for a long period of time by many subsequent users.

The proposed toolkit highlights new types of design opportunities and rationales for companies. In particular, it points to that companies do not have to develop business models with themselves as the nexus of circularity. Instead, they can develop products and services fit for circular consumption that enable products to be transferred from use to use. The toolkit also emphasises that design opportunities commonly framed from a production or business perspective can be addressed from a user perspective, which is often overlooked in other available tools. For instance, facilitating dis-assembly is a common strategy to enable circular production processes, but it may be just as important for users to be able to disassemble a product so that they can conveniently transport it to new users. From a design point of view, facilitating dis-assembly for users may be very different from facilitating dis-assembly in a production line. Hence, if a product is to be frequently shared, rented, or sold second-hand, it may be better to

optimise the design so that it can be exchanged easily from use to use rather than to optimise it for re-production flows. Lastly, it needs to be acknowledged that this toolkit only provides some of the tools that a company could (and maybe should) use to design for product circularity. Although using the toolkit may result in new insights about users, and novel ideas that could be attractive to people, one needs to ensure that these ideas are not disadvantageous, e.g. from a business or a sustainability perspective. These perspectives need to be considered as well, for instance by using other specialised tools to in-depth explore different business cases and conduct life-cycle analyses.

#### 4.2 Implications for design practice

In practice, the proposed toolkit has potential to support design processes by aiding designers and other agents to apply a user perspective on product circularity. As described by [10], a user-centred perspective on circularity entails reflecting on how the company can contribute to the consumers' processes, and not the other way around. The toolkit has potential to aid such design work in several ways. It includes an educational tool which helps designers and other agents to embrace a user perspective on product circularity, explorative tools that support user needs elicitation, as well as ideation and evaluation tools that support hands-on design activities with a user focus. The toolkit will hence facilitate user-centred design processes, i.e. development processes that proceeds with the user as the centre of focus [23], aimed at developing new products and services for the circular economy.

The use of the toolkit can contribute to new successful designs in two main ways. First, by grounding the development of new products and services on user insights, the toolkit will increase the likelihood that the designs will be accepted and adopted by the target group and decrease the risk of market failure. Second, using the toolkit will also enable companies to increase their value propositions and provide products and services fit to compete on a future market where linear consumption has lost its momentum. Designing products so that they, for instance, become easier for people to sell on the second-hand market is not a priority among companies today, since it rarely makes the products more attractive when sold as new. However, in a future with fierce competition for resources, more people might contemplate how to pass their products on already before buying them, which in turn can make companies designing for people's circular consumption processes more competitive.

#### 4.3 Future work

The proposed toolkit in its current form provides new tools for designers to address product circularity from a user perspective, and the response so far has been highly positive from the practitioners and students who have applied it. It is however in need of additional testing and possibly also further development.

Additional testing will be conducted to explore the tools' usefulness, user friendliness, their fit with companies' current design processes and other tools in use, and their potential to contribute to new innovative designs fit for circular consumption. Activities to test the tools will be carried out with representatives from industry in upcoming research projects but also with design students.

In addition to further testing, future work will also include exploring if any additional tools are required in order to cover additional aspects relevant from a user perspective, which are not already covered by the proposed five tools. This work should, among other activities, include studying people's consumption processes in more depth to gain insights into other aspects that are relevant to address when aiming to design products and services fit for circular consumption.

## 5 CONCLUDING REMARKS

This paper introduces *the Use2Use design toolkit* which should be seen as complementary to previously suggested tools for circular design. In contrast to other tools, the proposed toolkit and its five tools provides support to explore circular design opportunities from a user perspective. The toolkit will specifically aid designers and other agents to embrace a Use2Use mindset, to explore user needs, to pinpoint relevant consumption-related design challenges, and to identify new design opportunities to support circular consumption.

## ACKNOWLEDGEMENTS

The toolkit presented in this paper has been developed by the authors. This would not have been possible without the valuable contributions of a number of people: Helena Strömberg and Sara Renström at Chalmers University of Technology; Stina Behrens, Kajsa Davidsson and Maria Bergström at the service design firm Transformator Design (today the business design studio itch); and Daniel Ekfjorden with colleagues at Hultafors Group. The authors would also like to thank the students and company representatives that have taken part in testing the different versions of the tools and provided valuable feedback.

The toolkit was developed as part of a research project supported by the Kamprad Family Foundation. The funding body was not involved in the conduct of the research or in the preparation of the article.

## REFERENCES

- [1] Bakker C, den Hollander M, Van Hinte E, Zijlstra Y (2014) Products that last: Product design for circular business models. TU Delft Library, Delft, the Netherlands
- [2] Bocken NM, de Pauw I, Bakker C, van der Grinten B (2016) Product design and business model strategies for a circular economy. J Ind Prod Eng 33(5):308-320

- [3] IDEO, Ellen MacArthur Foundation (2017) The circular design guide. <https://www.circulardesignguide.com/> (accessed 28 February 2019)
- [4] Evans J, Bocken NMP (2013) The circular economy toolkit. <http://circulareconomytoolkit.org/about.html> (accessed 28 February 2019)
- [5] Makatsoris H, Moreno MA, Sheldrick L, Dewberry E, Sinclair M (2017) Business as unusual: Designing products with consumers in the loop. Project report, Cranfield University, <https://doi.org/10.17862/cranfield.rd.5226430> (accessed 26 June 2019)
- [6] Almfelt L, Rexfelt O (2017) A tool for assessing customers' barriers for consuming remanufactured products. In: Proceedings of the 21st International Conference on Engineering Design (ICED 17) Vol 1: Resource Sensitive Design, Design Research Applications and Case Studies, Vancouver, Canada, 21-25 August 2017
- [7] van Dam SS, Bakker CA, de Pauw I, van der Grinten B (2017) The circular pathfinder: development and evaluation of a practice-based tool for selecting circular design strategies. In: Proceedings of PLATE 2017 conference on Product Lifetimes and the Environment, Delft University of Technology, Delft, the Netherlands, 8-10 November 2017
- [8] Kirchherr J, Reike D, Hekkert M (2017) Conceptualizing the circular economy: An analysis of 114 definitions. *Resour Conserv Recy* 127:221-232
- [9] de los Rios IC, Charnley FJ (2016) Skills and capabilities for a sustainable and circular economy: The changing role of design. *J Clean Prod* 160:109-122
- [10] Selvfors A, Rexfelt O, Renström S, Strömberg, H (2019) Use to Use - a User Perspective on Product Circularity. *J Clean Prod* 223:1014-1028
- [11] Camacho-Otero J, Selvfors A, Pettersen Nilsen I, Boks C (2019, forthcoming) Circular design tools: (how) do they understand the consumer? In: Proceedings of the 3rd PLATE 2019 conference on Product Lifetimes and the Environment, Berlin, Germany, 18-20 September 2019
- [12] Selvfors A, Rexfelt O, Strömberg H, Renström S (2018) Re-framing Product Circularity from a User Perspective. In: Proceedings of DRS 2018 conference, Design Research Society, Limerick, Ireland, 25-28 June 2018
- [13] Brezet H, van Hemel C (1997) Ecodesign: a Promising Approach to Sustainable Production and Consumption. United Nations Environment Programme, Paris, France
- [14] Chalandon O, Lindborg P (2019) Improvement of an inventory management app and development of a sharing feature. Thesis for the degree of Master of Science, Chalmers University of Technology, Gothenburg, Sweden
- [15] Lindgren S, Trens O (2019) A digital platform for sharing assets within the culture sector. Thesis for the degree of Master of Science, Chalmers University of Technology, Gothenburg, Sweden
- [16] Janebäck E, Kristiansson M (2019) Friendly robot delivery. Designing an autonomous delivery droid for collaborative consumption. Thesis for the degree of Master of Science, Chalmers University of Technology, Gothenburg, Sweden
- [17] Hagman E, Wendt L (2018) Design for Exchange – Developing guidelines and exploring opportunities to design a tent for circularity. Thesis for the degree of Master of Science, Chalmers University of Technology, Gothenburg, Sweden
- [18] Rosman J (2018) A user centered approach to circular product design – Proposing guidelines and using them to design furniture as a service. Thesis for the degree of Master of Science, Chalmers University of Technology, Gothenburg, Sweden
- [19] Philipson N, Wallner A (2017) Urbanears Modular – an adaptable headphone system to extend lifetime. Thesis for the degree of Master of Science, Chalmers University of Technology, Gothenburg, Sweden
- [20] Kuikka F, Swenne L (2017) Design guidelines for shared cars. Development of design guidelines for Human Machine Interfaces and User Experiences in cars designed for carsharing. Thesis for the degree of Master of Science, Chalmers University of Technology, Gothenburg, Sweden
- [21] Pugh S (1981) Concept Selection: A Method that Works. In: Proceedings of International Conference on Engineering Design, Heurista, Zürich, 9-13 March 1981
- [22] George ML (2003) Lean Six Sigma for service: How to use lean speed and Six Sigma quality to improve services and transactions. McGraw-Hill Education, New York
- [23] Rubin J (1994) Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests. John Wiley & Sons, New York