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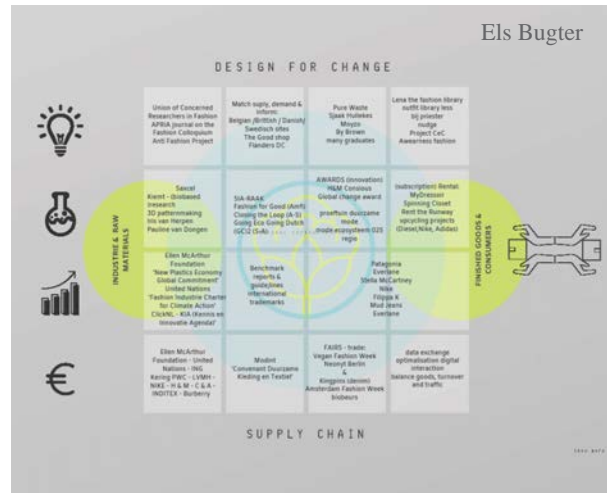


UNSEAM

Circular Intimacies



Buro Belén



Els Bugter

End report

Circular Design work package
 ‘Going Circular, Going Cellulose’

February, 2021

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1. Introduction

In the transition towards a circular economy, and towards a circular fashion and textile system, there is an increased awareness of the importance of interdisciplinary, multi-stakeholder collaborations and co-creation. However, creating circular supply and value chains in textiles and fashion, and thus designing out waste and pollution, is far from straightforward. It requires a systemic change and “it will take collaboration and a coordinated joint effort to make it happen” (Wennberg & Östlund, 2019: 25). While the industry, designers, manufacturers and knowledge institutes seem more and more aligned towards a common global goal, within these interdisciplinary collaborations everyone often speaks their own language and has their own assumptions and ways of working. Yet, in order to contribute to this transition together, a close collaboration – building on a sense of trust as a precondition to sharing knowledge, experience and ambitions – is required. This also requires a sense of proximity to co-develop processes and products, to do experiments and tests, which contributes to developing a mutual understanding in doing so. Such proximity is especially challenging for the fashion and textiles industry, in which spatially and organizationally fragmented value chains have become almost the norm (cf. Köppchen, 2014; Lane & Probert, 2009). The more stakeholders are involved and the more these actors are globally dispersed, the harder it gets to align interests and collaboratively work towards shared sustainable goals.

Several authors (cf. Bocken et al., 2016; Ellen MacArthur Foundation, 2020b) have claimed that design plays a vital role in this endeavour, as “80 to 90% of a product’s lifecycle impacts are decided during the design phase” (Hornbuckle, 2018: 24). There is an increased awareness of the role of the designer as a potential key actor in making sustainable choices by being more and more involved in material development and production processes. Designers increasingly work from the possibilities of the material, and design from the material itself, instead of just making beautiful end products. This requires developing more (technical) knowledge about processes of making and production methods, to develop circular solutions and sustainable innovations, as well as more knowledge of circular design principles in relation to interdisciplinary co-creation and value creation. This demonstrates the potential of the role of design in relation to the transition to more circular value chains. However, the exact role that designers can and should play and the challenges that designers face regarding their responsibilities and required competencies is an ongoing discussion (cf. Niinimäki et al., 2017; Sumter et al., 2018).

Therefore, the project ‘Going Circular, Going Cellulose’, in short (GC)², explored an integrated process of multi-stakeholder value creation from a design-driven perspective on textile development. It built upon the project ‘Going Eco, Going Dutch’ (2015-2017), which was led by the Centre of Expertise Future Makers of ArtEZ University of the Arts and by Saxion University of Applied Sciences. ‘Going Eco, Going Dutch’, in short GEGD, investigated the production, design and branding of textiles made from locally produced hemp fibers in the Netherlands. It did so by involving multiple stakeholders from the production of fibers to branding and retailers in order to create a local and circular textile chain. The main focus was on the (technical) development of yarns from combinations of recycled fibers, hemp and polyester and Tencel. The project also explored the development of a visual identity for the textiles made from these yarns, which was created by using Dutch traditional crafts – a collaboration between the ArtEZ MA Fashion Design and the Crafts Council. In addition, this project highlighted the importance of storytelling (as a branding strategy) by focusing on the values of locality and transparency, which led to the development of a concept for a circular brand called ‘Van O – by...’ by students of the ArtEZ MA Fashion Strategy. In the context of this project, researcher Zinzi de Brouwer explored *design for recycling and recycling in design principles* – a pilot of design guidelines for students and emerging designers (De Brouwer, 2017).

The project GEGD demonstrated the importance of co-creation between scientists, engineers, industry partners and designers to optimize processes of recycling and upcycling. In addition, the project highlighted the importance of the physical proximity of all actors in the value chain as well as the importance of locality for a circular value chain. While the project had started exploring an integrated multi-stakeholder and interdisciplinary collaboration for a circular value chain based on sustainable fibers, it also exposed the need for more knowledge development on processes of co-creation. Moreover, as the focus had primarily been on technical material development, in this research project, there was less attention for design and for developing circular design methodologies, for example in terms of value creation around locally produced textiles and related to creating meaningful relationships with the consumer.

Therefore, the follow-up project (GC)² aimed at drawing more attention to an integrated approach of technical design, aesthetic design and product design. In doing so, it investigated how to improve processes of co-creation focused on the technical development of yarns (based on sustainable cellulose fibers) and fabrics with a central role for design. As part of a design-driven approach, the project aimed at having designers participating proactively in the early stages of material development and production processes – based on the hypothesis that this is essential for a circular design process. By focusing on an integrated approach of multi-stakeholder interaction, the original aim was to create a stronger synergy between technical design and aesthetic design to create more knowledge on circular development methodologies for a circular value chain of fashion and textiles (Grevinga, 2017: 2). The project (GC)² started from the following central research question:

How can an integrated, interactive process of technical, functional and aesthetic product design lead to an optimal use of sustainable textiles and to optimizing the circular value chain of textile and fashion?

Within this context of the project's main focus, the 'circular design' work package (WP 4) specifically aimed at exploring an integrated, interactive approach from a design-driven perspective – building upon the design principles of the report 'Closing the Loop: Design Guideline for Recycling' (De Brouwer, 2017). This work package thus primarily focused on developing circular design principles and on developing a better understanding of a design-driven approach to multi-stakeholder co-creation for a circular value chain. As the report 'Closing the Loop: Design Guideline for Recycling' shows, value-creation (e.g., aesthetic value, social-cultural value and emotional value) and transparency regarding circular production processes of sustainable materials is at the core of a design-driven approach. Through an iterative process of research-through-design, and monitoring that process, this work package thus aimed at further developing and putting into practice circular design principles that are central to an integrated multi-stakeholder and circular approach of developing textiles. This work package started from the following research question:

Which circular design principles are essential for the transition to a circular textile and fashion chain, and which form of value-creation is important when designing and developing sustainable textiles and clothing (made from sustainable cellulose fibers)?

This work package focused on research-through-design of sustainable clothing and fashion, as well as of sustainable textiles for interior and product design applications. In doing so, and by monitoring and reflecting on these research and design processes, the work package aimed at developing more knowledge and in-depth insights into circular design principles and multi-stakeholder value-creation (including the immaterial value of the objects).

We selected six fashion/product designers (or design duos) who represent a variety of design approaches. Some are more focused on production processes or on technical yarn development, while others focus on a systems approach, on the aesthetic dimension of textiles, on the relationship with the consumer, or on a combination of approaches. The selected designers and design duo's are: (1) Hellen van Rees, (2) Els Bugter (Tous les Chéris), (3) Michelle Baggerman (Bureau Baggerman), (4) Suzanne Oude Hengel & Milou Voorwinden, (5) Karin Vlug & Bas Froom (UNSEAM) and (6) Lenneke Langenhuijsen & Brecht Duijf (Belén). These designers all developed their own research proposals and proactively collaborated with the technical, industrial and research partners of the (GC)² project, including Saxion University of Applied Sciences, Enschede Textielstad, Alcon Advies, Permess, and JB Textiles.

By closely monitoring these design projects, Zinzi de Brouwer continued her research into circular design principles – testing the design principles of her pilot 'Design Guidelines' and further developing these as well as new principles, which she has described in her report 'Recommendations for a Circular Design Practice' (2020).

In this end report of the circular design work package, we discuss our findings regarding a design-driven approach to multi-stakeholder and interdisciplinary forms of collaboration that can be understood as co-creation, while reflecting on our new insights regarding (newly developed) circular design principles. We first reflect (in chapter 2) on the methodology of (monitoring) the research-through-design projects and of developing circular design principles. In chapter 3, we reflect on existing literature, knowledge and theory on co-creation and co-design in relation to circular design principles in the fields of fashion and textile. In chapter 4, we discuss our key insights based on our case study analyses of how the participating designers put circular design principles into practice, based on which we (in chapter 5) reflect on our key conclusions regarding (the role of designers in) co-design for circularity. In chapter 6 we conclude our reflections by focusing on trust, empathy, transparency and communication.

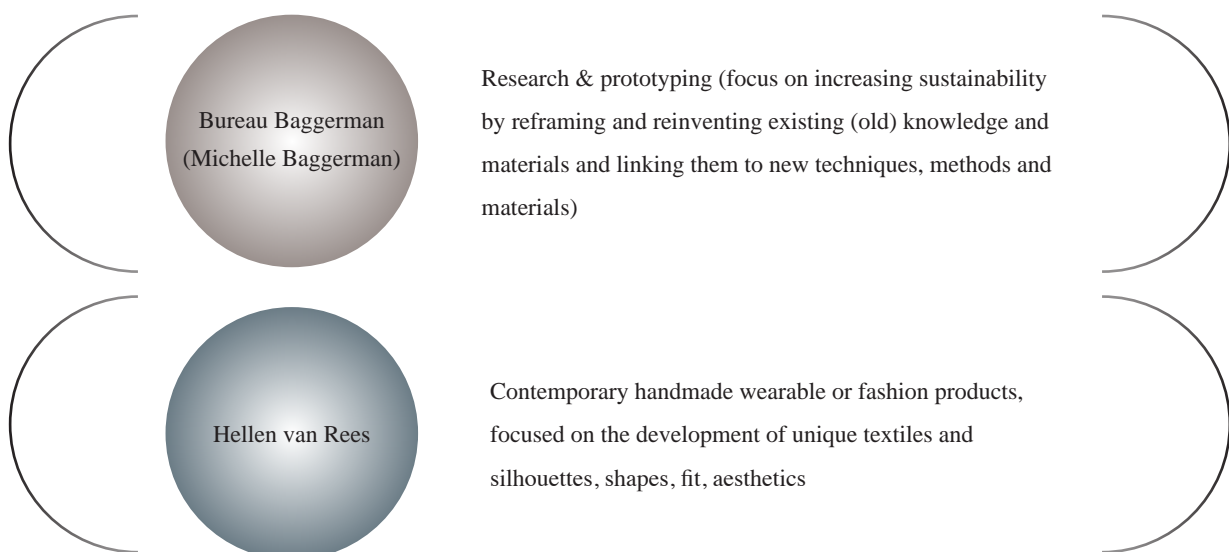
2. Methodology

As explained in the Introduction, the circular design work package aimed at developing more knowledge and in-depth insights into circular design principles and multi-stakeholder value-creation. The key methodologies of this work package were: (1) research-through-design by the participating designers, to develop sustainable textiles and new insights into circular design principles in doing so; (2) creative practice-based research and concept development on circular design principles and their underlying values; and (3) monitoring the design projects and case study analysis by the project's monitoring team.

2.1. Research-through-design (WP 4.1 and 4.2)

Since a design-driven approach to circular textile development and multi-stakeholder value creation is important to this project, we started by inviting and selecting designers to play a proactive role. Based on the project set up, we decided that the project would benefit from different kinds of designers and design researchers who represent a variety of approaches: content-based designers with an interest and/or expertise in circular design and multi-stakeholder value creation and designers with a focus on developing products specifically in the fields of textile, fashion and furniture/interior design. In addition, these different kinds of designers, represent different approaches ranging from a focus on knowledge development, to a systems approach, a focus on production processes, the relationship with the consumer, the aesthetic dimension of textiles, to a focus on material/product development and technical yarn development. Due to an existing collaboration, two designers (Hellen van Rees and Els Bugter / Tous les Chéris) had already been selected as project partners by Saxion.

In addition, based on our longlist, we invited five designers to a workshop on September 26, 2018 at Future Makers in Arnhem, during which the project team presented the aims related to the circular design principles and to the integrated way of doing research and development in close collaboration with all project partners. All designers were invited to present their work and ideas on how to contribute to this project, based on which it became clear which designers and design duos were a good match for the project. This led to the following selection of designers and design duos, who also operated as case studies for the monitoring team:



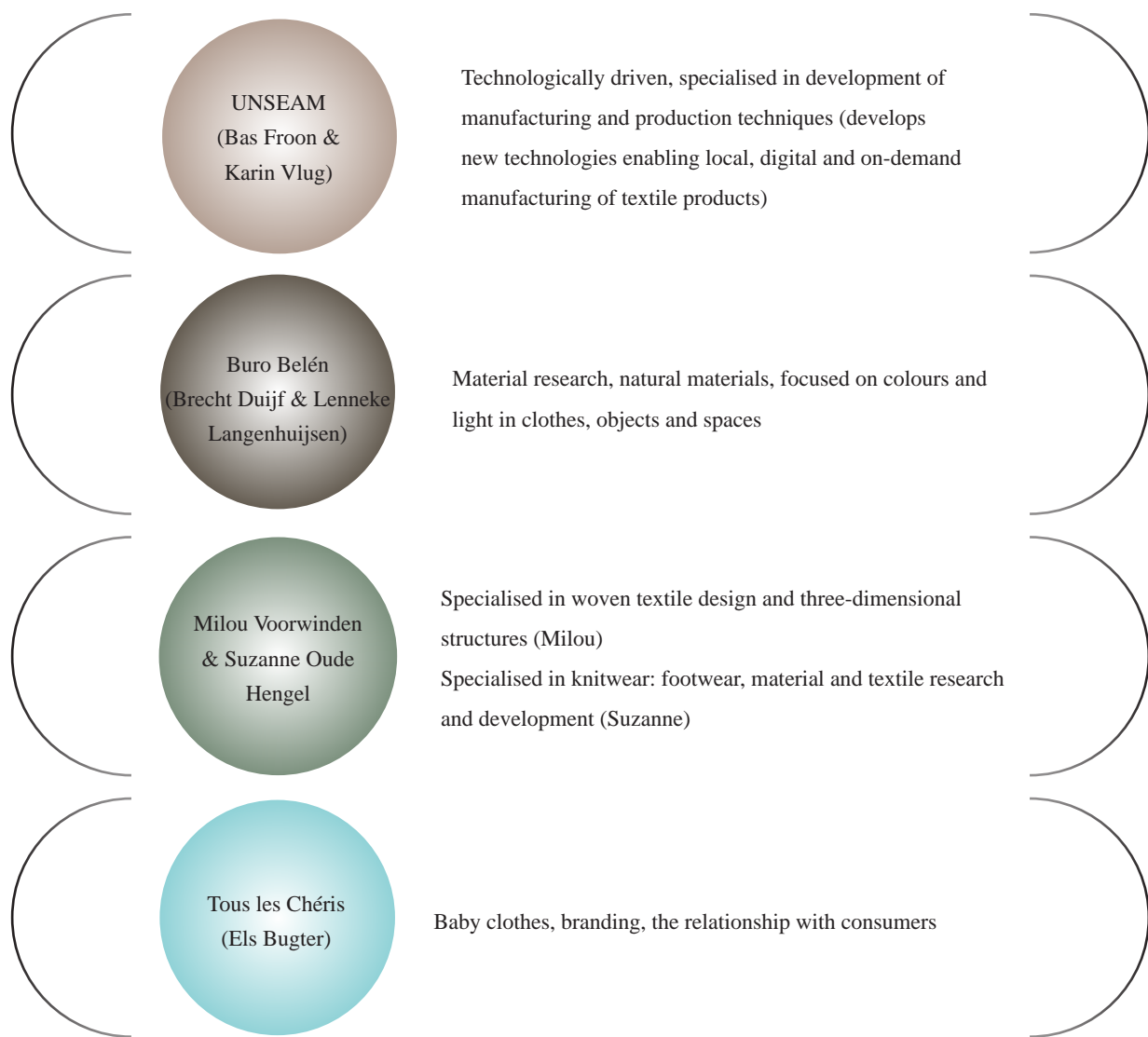


Fig. 1: Selection of designers and design duos

All designers were asked to read the ‘Design Guideline for Recycling’ (2017), developed by Zinzi de Brouwer in the context of the previous project *Going Eco, Going Dutch* (2015-2017). The initial intention was that this would serve as a framework and as a starting point for the designers’ research within the (GC)² project in order to further develop and test these design principles. In addition, four tours and work sessions were organized, hosted by the key industry and research partners Saxion, Enschede Textielstad, Alcon Advies, Permess, and JB Textiles – in order to offer the designers a better idea of what collaborating with these partners would entail and how that could contribute to their project ideas. These introductory work sessions allowed all designers and partners to explore each other’s expertise and opportunities to collaborate within the project.

Based on these introductory work sessions and based on their own expertise and research interests, all designers developed their research proposals for their own subprojects within this work package, which included their research questions (evidently, within the scope of the project) and their plan on how to proactively approach the collaboration with the industry and research partners of the (GC)² project. Each design project thus followed its own logic and methodology of doing research-through-design and of multi-stakeholder co-creation. Taking these design approaches as a starting point was important for the overall design-driven focus of the project and allowed exploring a variety of circular design practices and approaches as well as different forms of co-creation with the key partners. For the purpose of the project, all designers documented their design process (e.g. visual documentation, notes of meetings, sharing samples and material experiments, etc.).

2.2. Creative practice-based research for concept-development on circular design

In order to reflect on these design-driven approaches and on the extent to which (new) circular design principles related to co-creation were developed and put into practice by the designers, the project team organized 5 check-in meetings with specific creative design exercises.¹ These check-in meetings included the design exercises that were focused on the following topics.

(i) June 4, 2019: *shared values and circular design principles (pyramids)*:

During this check-in meeting, the designers were asked to evaluate their personal design approach according to the circular design strategies framework of Bocken et al (2016). Each designer was asked to choose several circular design strategies that describe his/her personal approach and rank them according to their significance, thus prioritizing these in a pyramid. In case a designer did not feel his/her approach was represented in the provided strategies, he/she was asked to add or describe additional strategies that capture the approach. After the exercise the designers were asked to shortly elaborate on the selected and added strategies in the context of their personal proposal and approach.

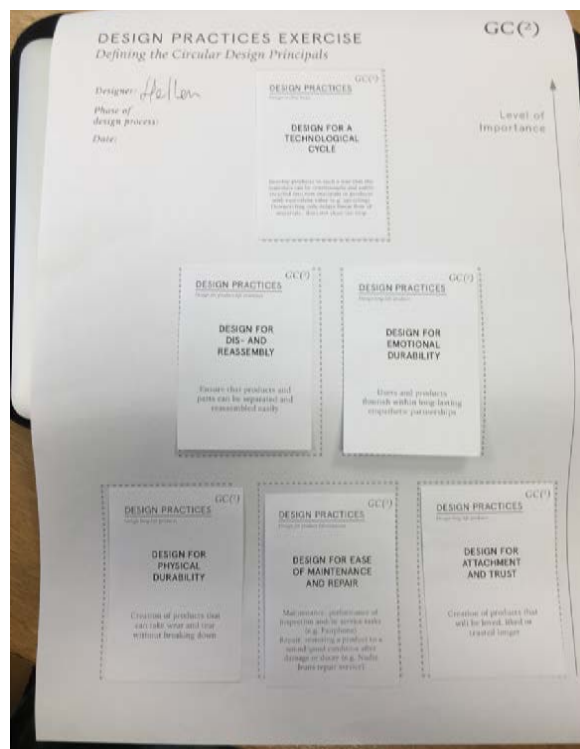


Fig. 2: circular design principles pyramid by Hellen van Rees, check-in meeting June 4, 2019.

¹ The creative design exercises for the designer check-in meetings were primarily developed by fashion strategist Zinzi de Brouwer, who also built upon the literature study done by Freya Zaplata and was supported by research intern Mariane Meirelles and the monitoring team. For more detailed information, please see the report on the *Design Guidelines 2.0 – Recommendations for a Circular Design Practice* by Zinzi de Brouwer (2020).

(ii) July 1, 2019: *defining challenges, circular brainstorm, and developing a shared language / vocabulary:*

Borrowing from the methods of the Circular Design Guide by the Ellen MacArthur Foundation and IDEO², in the second check-in meeting designers were asked to 'define their challenges'. This helped them to articulate and frame what circularity challenge should be solved and what impact the project members wished to have, thus clarifying goals and aligning the project approach. The exercise 'Circular Brainstorm' was based on specific questions and aimed at better understanding how research-through-design, material development and concepts were practiced. In addition, all project partners were invited to share their interpretation of key terms within the project: designer, co-creation/collaboration and sustainability.

(iii) September 18, 2019: *process update designers (no specific design tools used)*

(iv) October 28, 2019: *collaboration matrix / co-creation*

The collaboration matrix is a tool that was used in the recently completed EU funded Trash-2-Cash project (2019). The aim of this matrix is to dive deeper into the question of how co-creation works within this project; to capture and visualise collaboration practices and intentions from different perspectives.

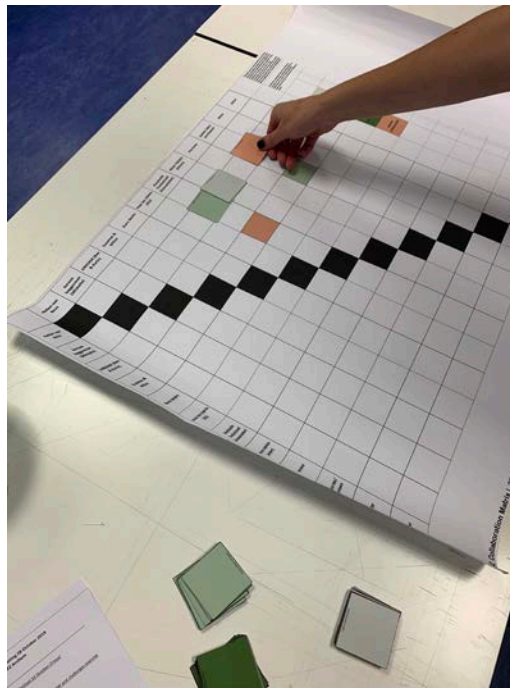


Fig. 3: collaboration matrix by Michelle Baggerman, check-in meeting October 28, 2019.

(v) December 12, 2019: *discussion on (changing) role of the designer.*

The final exercise aimed to reflect on the different roles the designers felt they take on within the (GC)² project. The monitoring team pre-defined a number of possible roles based on preliminary conclusions of the monitoring process and on roles mentioned in the literature (e.g. Baldassare et al., 2019; Niinimäki, 2018; Sumter et al., 2017; Williams, 2014). The designers were also invited to define their own roles and were asked to illustrate their roles with at least one concrete example/practice from the (GC)² project. Secondly, the designers reflected on these roles in relation to their design principles pyramid to explain the role they take when designing according to these principles. And thirdly, the designers described their main roles within the collaborations that they felt were most valuable or relevant for them within the project.



Fig. 4: Examples of designer cards of different possible designer roles, used for the fifth exercise on December 12, 2019.

By closely monitoring the design projects and by inviting the designers to do these creative design exercises during the check-in meetings, project member Zinzi de Brouwer was able to extend and further develop the design principles of her pilot ‘Design Guidelines for Recycling’ (2017), as she discusses in the ‘Design Guidelines 2.0’ (2020). Some of these exercises also served as a basis to build a framework and process for the design research as well as to encourage circular behavior. This also offered insight into how a circular design toolkit could be put into practice.

In addition to critically and creatively reflecting on circular design principles and questions of co-creation, the designer check-in meetings also served as a moment and space to exchange ideas, knowledge and questions among the designers.

2.3. Monitoring design projects & case study analysis

The project’s team investigated the design-driven research process – focusing on the process of developing, testing and/or applying (new) circular design principles and on the process of multi-stakeholder collaboration and interdisciplinary co-creation.³ We did so by closely monitoring the design projects, collecting empirical data through

interviews and participatory observation, and by conducting a qualitative case study analysis (with each designer and/or design duo as a case study). Members of the monitoring team scheduled regular monitoring interviews with the designers; joined and observed project meetings initiated by the designers with other research and industry partners; joined and observed consortium meetings with all stakeholders and project partners; and participated in the designers' check-in meetings.

In order to analyze the project's design-driven interdisciplinary multi-stakeholder collaboration, our monitoring process was inspired by and built upon the framework for design-driven material innovation, as developed by Kirsi Niinimäki (2018) and as applied in the recently completed European project *Trash-2-Cash* (Tubito et al., 2018).⁴ With the aim to incorporate Life Cycle Thinking into the heart of the design and development process, the T2C consortium developed and tested a four-stage process towards collaborative and interdisciplinary design (Goldsworthy & Ellams, 2019). Co-creation in this process happens on different levels, evolving from *co-playing and co-dreaming* (identifying what we are working towards together), to *co-visioning* (building a shared mindset, shared mission and a common goal) and *co-producing* (realizing the collectively developed aims) (Niinimäki, 2018; Tubito et al., 2018).

This framework for a design driven process for innovation helped to further identify and define how different stakeholders collaborate in developing innovations. In order to allow for a flexible and iterative design research process, tailored towards each designer's aims and ways of working, we did not strictly follow the same four-stage process as developed by the T2C project. Instead, the (GC)² designers followed their own logic and the T2C framework, including the different dimensions of co-creation, served as a starting point for the monitoring team to reflect on the designers' practices and to understand what co-creation means in these different contexts.

During each monitoring session, interview or meeting we aimed to gain a deeper insight into the role of co-creation and the meaning of circular design principles for the designers. We thus reflected on these different levels of co-creation by discussing the development of shared mindsets, values, missions and future visions, as well as different types of knowledge and value creation, and how designers experience their own roles in relation to other stakeholders. We also focused on the designers' learning processes and the challenges and (knowledge) gaps that designers faced when collaborating in different stages of the process. We conducted semi-structured interviews in order to guarantee sufficient room for the designers' personal experiences and approaches. Minutes, notes, observations and/or recordings of these interviews form important data for our case study analyses. These minutes also led to follow-up questions that informed the next designer check-in meeting. By doing so, the monitoring team also supported the designers in reflecting on their process.

Based on the empirical data collected in the period of March 2019-March 2020, we conducted a qualitative analysis of the case studies (the projects of participating designers and/or design duo's), which facilitated an in-depth investigation of the various design-driven approaches and multi-stakeholder interactions. Empirical data also included the designers' project proposals, visual documentation and presentations of the design process, as well as the results of the design exercises during the collective designer check-in meetings. In addition to monitoring the interdisciplinary collaboration, the interviews and check-in meeting with the designers evidently also addressed

3 Members of the monitoring team were Zinzi de Brouwer, Daniëlle Bruggeman, Jeroen van den Eijnde, Anja Köppchen, and Freya Zaplata.

4 <https://www.trash2cashproject.eu/>

applying and developing circular design principles. Our case study analysis was thus an iterative process of literature study on circular design principles, collecting empirical data through observation and interviewing the designers about these principles, and cross-case / comparative analysis.

3. What we (don't) know about co-creation

We have learned from the experiences in 'Going Eco, Going Dutch', that multidisciplinary collaboration between designers, textile manufacturers and textile engineers is essential for creating a circular value chain and can support the development of innovative sustainable materials and products. In the field of fashion and textiles, aesthetic, emotional and socio-cultural value is intertwined with technical, functional and commercial value. Designers supposedly play a vital role in this multi-layered value creation. Co-design and co-creation of aesthetic, technical and functional value through multi-stakeholder collaboration seems to be a crucial factor in the transition towards circular value chains in textiles and fashion. However, questions remain about the exact role of designers in this transition and how co-creation works in different contexts.

This project is based on the principle that multi-stakeholder collaboration and interdisciplinary co-creation is a valuable and even necessary condition for the transition towards circular value chains in textiles and fashion. We all agree that a circular economy requires a joint effort of all stakeholders involved. However, the concept of co-creation has become somewhat of a 'buzzword', as it has gained interest in a variety of (research) fields with different meanings in different contexts. Without aiming to be complete, let us start with a brief exploration of the concept of co-creation as it has been understood in literature and (fashion and textile) research.

3.1. The essence of co-creation is not new

Whereas the first use of the concept dates back to the 1970s, there has been an explosive growth of articles on co-creation since the turn of the century (see Degnegaard (2014) for a literature review). The largest part of the literature focuses on the fields of marketing and service, as well as user-driven co-creation and innovation (e.g. Prahalad & Ramaswamy, 2004). Here users become innovators in the co-production of value in products, services and experiences, as well as in the co-creation of technological solutions in ICT (Degnegaard, 2014). Next to this marketing and (product) innovation perspective, Degnegaard (2014) identifies design-driven co-creation, which focuses more on human needs and values, and is related to community-based problem solving. Design-driven approaches according to Degnegaard ask "how we might design co-creation settings for impact on society-wide challenges such as safety and security, health care and sustainability" (2014: 107). The latter concept of co-creation is also known as participatory design and is related to social innovation (cf. Mattelmäki & Sleeswijk Visser, 2011).

Both participatory design and consumer-driven value co-creation are based on the premise that not only designing FOR, but especially designing WITH the (future) user leads to better addressing what people actually need. Co-creation thus means that designers actively involve the people they are designing for and companies actively involve the people they are producing for. Sanders & Stappers (2008) have provided a valuable and much-cited contribution to our understanding of the concept and the changing position that designers take in such a setting. They address the transition from traditional design disciplines that focus on the design of 'products' to emerging disciplines focusing on "designing for a purpose" (Sanders & Stappers, 2008: 11). To design for a purpose requires a different approach in which the needs and values of stakeholders are the starting point for an open-ended (co-design) process. The roles of the stakeholders that are involved in a co-creation or co-design process get mixed up, as users can become co-designers, researchers (who can also be designers) become facilitators and designers are

“needed because they hold highly developed skills that are relevant at larger levels of scope and complexity. By selection and training, most designers are good at visual thinking, conducting creative processes, finding missing information, and being able to make necessary decisions in the absence of complete information. [...] As the scope and complexity of design problems increases, we will need the special skills and abilities of designers to help in the way ahead” (Sanders & Stappers, 2008: 15).

Sanders & Stappers define co-creation as “any act of collective creativity, i.e. creativity that is shared by two or more people” (2008: 6), which means that creativity is not an exclusive skill of designers. Instead, the process should facilitate creative involvement of all stakeholders in close collaboration. In practice – also among the designers involved in (GC)² – it is not always evident where, when and how collaboration turns into co-creation. We tend to speak of collaboration and co-creation as if they were interchangeable concepts. Yet the difference lies in shifting power relations. In the traditional notion of a value chain, each actor consecutively adds value to a product and collaborations are usually limited to buyer-supplier relations. When we aim for co-creation in circular value chains, different stakeholders collectively create value, which also implies a change in attitude and a sense of shared ownership. This is where the transition towards circular chains gets difficult, because a systemic change requires more than designing products for recycling and disassembly. As Pedersen & Clausen point out, “the involved stakeholders often have multiple agendas and interests” (2019: 3372), which need to be negotiated and re-aligned:

“The involvement of many actors in the design process makes design not only a process of change but also a political process where different concerns and perspectives are to be taken into account and negotiated across the diverse actors” (Pedersen & Clausen, 2019: 3373).

Co-creation thus is not just a matter of how to share and build on each other’s knowledge and expertise and how to make sure that every stakeholder can fully unfold its creative potential, but it also requires to facilitate dialogue to address potential conflicts, contradictions and incompatible expectations, and to negotiate and re-align stakeholders’ agendas and interests.

3.2. Co-creation in fashion and textiles

If we look for ways in which the concept of co-creation has been addressed in fashion research, it is first and foremost explored in terms of value co-creation between brands and consumers, especially to improve brand loyalty (e.g. Choi et al., 2016; Von Maltzahn, 2013) and to better understand and more effectively apply (online) marketing strategies (e.g. Roncha & Radclyffe-Thomas, 2016; Scuotto et al., 2017). We find only few in-depth contributions to understanding the value and role of co-creation in the development of sustainable textiles and a circular fashion industry. Two of them in particular are worthwhile to explore in more detail. The first one is provided by publications based on the European Union’s Horizon 2020 project Trash-2-Cash (T2C), which run from 2015 to 2018 (Tubito et al., 2018), as we already introduced in chapter 2. The second valuable contribution we find in publications stemming from the Mistra Future Fashion (MFF) Research Program (2011-2019), which was funded by Mistra, the Swedish Foundation for Strategic Environmental Research, and coordinated by RISE Research Institutes of Sweden⁵ (cf. Wennberg & Östlund, 2019; Goldsworthy et al., 2019). Many of these projects’ insights once more confirm and underline the relevance of interdisciplinary collaboration and we see them as encouragement and inspiration to

⁵ <http://mistrafuturefashion.com/>

further explore and develop new and alternative ways to contribute to the transition towards circular value chains and systems in textiles and fashion.

Drawing on the principle “that problems of material circularity cannot be solved by any discipline in isolation” (Hornbuckle, 2018: 27), the T2C project in particular looked at the role of designers and design knowledge and skills in an experimental co-design approach to material innovation. According to Niinimäki, one of the research partners within the T2C project, the knowledge, skills, attitudes and values that designers bring into the process (e.g. imaginative storytelling and market- and user-centred viewpoints) add “sensorial, user-centred and functional attributes to the development of new materials” (2019: 1783). She furthermore identifies deep learning as one of the main project outcomes, especially for the material researchers involved, who became “more open towards collaboration and laid a new value base for appreciating other knowledge areas” (Niinimäki, 2019: 1783). The results and insights of the T2C project thus underline the potential of design-driven and interdisciplinary approaches to circular product development and support the key idea of (GC)² to understand the role of an integrated, interactive process of technical, functional and aesthetic product design in the transition towards circular value chains in textiles and fashion. The main contribution of the T2C project lies in the exploration of collaboration and design thinking methods and tools, within the specific context of using waste feedstock in the development of innovative textile materials and products. As mentioned in chapter 2, with the aim to incorporate Life Cycle Thinking into the heart of the design and development process, the consortium developed and tested a four-stage process towards collaborative and interdisciplinary design (Goldsworthy & Ellams, 2019) - evolving from *co-playing* and *co-dreaming* (identifying what we are working towards together), to *co-visioning* (building a shared mindset, shared mission and a common goal) and *co-producing* (realizing the collectively developed aims) (Niinimäki, 2018; Tubito et al., 2018).

While it is beyond the scope of this report to go into detail about the specific conditions and impact of each phase (see for a more elaborate explanation the project report by Tubito et al. (2018)), identifying different levels of co-creation illustrates how co-creation essentially is a learning process in which disciplinary boundaries need to be crossed and (knowledge) gaps need to be bridged. Especially the starting phase of product development, which is also called the *Fuzzy Front End*, comes with great uncertainty that requires a lot of effort and a certain mindset of all stakeholders involved (Niinimäki, 2018). Collaborative knowledge needs to be created in this open-ended, fuzzy process. It is argued by several authors that designers are used to work with such uncertainty, as well as having the competencies and tools to cross disciplinary boundaries through what Stompff & Smulders (2013) have called “mirroring”: designers enable collaborative reflection by creating representations such as prototypes and visual storytelling and thus facilitate to combine knowledge flows and to develop a shared language (see also Niinimäki, 2018; Niinimäki et al., 2017). It seems that designers increasingly get ascribed different roles and responsibilities that stretch far beyond the actual concept and product development. One of many roles of designers within the T2C project has been to facilitate the collaborative and creative process in multi-stakeholder workshop settings (Niinimäki, 2018). Designers in a co-creation setting thus become process designers and facilitators of the desired collective creativity. In the words of Manzini in the context of social innovation: “They can operate as social actors who, thanks to the cultural and operative tools available to them, are able to feed and support the design process in which all of us, experts and nonexperts, are involved” (2015: 1).

We may ask then: What do these emerging roles for designers in different co-design and co-creation settings mean in practice? How are designers operating within the complexity of fragmented value chains in textiles and fashion?

Does design-driven innovation mean that designers actually operate as ‘chain directors’? Whereas the T2C project focused specifically on the role of designers in the context of textile waste and new recycled materials, how can and should designers in different contexts approach the challenge of designing for circularity? How does their design practice relate to the different stakeholders both upstream and downstream the value chain and how can these be aligned? How do designers in different contexts actually experience their role as part of a co-design or co-creative process? Taking the valuable insights of the T2C project into account that were partly based on orchestrating the process and staging collaboration in co-design workshops, the approach of (GC)² has been more experiential by focusing on what actually happens in practice; how do individual designers and design duo’s with very different backgrounds both understand and experience co-creation practices in relation to circular design principles?

3.3. Co-creation and co-design for circular value chains in fashion and textiles

Based on existing research, we can observe an increased awareness of the need for collaborative, interdisciplinary and design-driven approaches to change the linear thinking within large parts of today’s fashion and textile industry. A sense of urgency for change among not just researchers but also industry stakeholders and consumer groups is clearly there, and tools and methodologies to facilitate co-creation settings and design thinking processes are freely available for everyone who wants to make an impact and design for circularity.⁶ Why is it still so challenging then? We know the principles, tools and conditions to facilitate collaboration and change, but how does co-creation actually work in practice, if it is not being orchestrated? The conditions of co-creation are quite well understood in theory (based on empirical research). However, co-creation in practice seems highly context-dependent. Likewise, experiences of co-creation within this project differ from case to case, which seems to be related to the variety of design research approaches. As we aimed to understand how conditions of co-creation are operationalized in practice, we learned that the concept of co-creation is not part of designers’ regular vocabulary. But while the designers and design duo’s in general had difficulties to understand and define the abstract concept of co-creation, some of them seem to co-create quite ‘naturally’ in practice, as we will further elaborate on in the following chapters. The case studies furthermore illustrate how designers do not only struggle with the complexity of questions of circularity and co-creation within fashion and textiles, they also see opportunities to address this complexity in novel ways.

Before diving into more detail about what we learned about co-creation from the six design research projects of (GC)², some clarification on the definition of co-creation within this project is needed. As has been explained, the ideas of co-creation and participatory design are not new, but some terms seem to be used interchangeably – especially the difference between co-creation and co-design has become blurred. Sanders & Stappers consider co-design as “a specific instance of co-creation” (2008: 6), whereas Mattelmäki & Sleeswijk Visser conclude the opposite: “Co-design is a process [...] built on a mindset based on collaboration. Co-creation can take place within co-design processes but focuses much more on the collective creativity of involved users and stakeholders” (2011: 11).

The six design research projects of (GC)² were design-driven in the sense that the process is initiated and driven by (research) questions of designers. We followed the process from the designers’ perspectives to understand how co-creation is experienced in practice and how it affects the process, outcomes and involved stakeholders. If we

⁶ Cf. The Circular Design Guide – a collaboration between the Ellen MacArthur Foundation and IDEO, <https://www.circulardesignguide.com/>

consider design to be a creative process to explore, conceive, create and implement desired outcomes in specific contexts, and thus see design as a crucial factor in the transition towards circular value chains in textiles and fashion, it makes sense to incorporate multi-stakeholder collaboration within the entire design process and thus strive for *co-design* processes and approaches in line with Mattelmäki & Sleeswijk Visser's (2011) definition. We might speak of *co-creation*, then, if something (tangible) is actually being (co-)created, be it materials, knowledge, technology, or a different kind of value. However, for the designers and other stakeholders reflecting on their practice it is not important whether the collaborative process is being called *co-design* or *co-creation*. That is primarily a semantic discussion. What is more important: how can different circular design principles benefit from a collaborative mindset and a co-creative process and what does it mean for the role of designers (as experienced in practice) within this process?⁷

⁷ These questions are also in line with the recently published research agenda 2020-2023 for Key Enabling Methodologies (2020), which addresses the need (among others) to understand the value of co-creation and participation methods in different contexts.

4. Circular design principles

Based on the data collected by monitoring the designers' research-through-design, and the creative practice-based research, in this chapter we will discuss our key findings regarding the circular design principles and strategies applied and developed in this project – reflecting on the new insights that contribute to existing knowledge on circular design principles. We will start with (1) a theoretical exploration to understand circular design principles and how they contribute to value creation; we then dive deeper into our case study analyses and discuss (2) how the designers understood and dealt with these circular design principles while putting them into practice.

4.1. Circular design principles in theory

In the literature, circular design principles and strategies are mostly described from a product design and technical/ industrial perspective (e.g. Bocken et al., 2016; Ellen MacArthur Foundation, 2020a). In the fields of fashion and textiles, circular design principles have not been explored extensively, especially in terms of practice and implementation. Most strategies are mainly techno-centric and do not address the social and cultural dimension of design in relation to circularity and sustainability. Fashion scholar Alice Payne has called this the myth of 'fashion's Prometheans': a 'techno-optimist' and rationalist worldview that "proposes a future in which cleaner technologies can lead to the gradual evolution of a better industry" (Payne, 2019: 6). Within this dominant discourse, design (practice) is often positioned within the fields of engineering, innovation management, and ecological and environmental sciences. Accordingly, most literature is concerned with developing innovations from a product and engineering design perspective (Lofthouse & Prendeville, 2018: 460; de los Rios & Chamley 2017). While the formulation of technical design criteria and material recovery strategies is a valuable and necessary discussion, it also has its shortcomings. As Kate Fletcher points out: "sustainability in fashion and textiles fosters ecological integrity, social quality and human flourishing through products, action, relationships and practices of use"(2013: xviii). In this project, we therefore recognize the importance of taking into account a social and cultural perspective on circular design, including the relationship between maker, object and wearer/user.

Based on our literature study on circular design principles and roles, in this chapter we primarily build upon the framework offered by Bocken et al. (2016), aiming to reframe, further develop and add to existing circular design strategies. Bocken et al. (2016) provide a list of circular design strategies focused on product (and industrial) design.⁸ Although the framework has been criticized for not being comprehensive enough by overlooking extant literature on Design for Sustainability (DfX) (Moreno et al., 2016)⁹, it provides a practical and well-defined yet still comprehensive overview of circular design strategies particularly suitable for our practical project approach. They introduce two main overarching strategies: (1) 'Slowing resource loops' and (2) 'Closing resource loops:

'Slowing resource loops' refers to the design of "long-life goods and product-life extension". The aim in designing long-life products is to ensure that products are kept in use for a long period of time. This ultimately slows down the cycle of used resources. The aim in designing for product-life extension is to prolong the use period of products.

⁸ In the respective article they furthermore focus on corresponding business model strategies.

⁹ The criticism of Moreno et al. shows that the discourses of sustainability and circular design provide a plethora of literature on design principles and strategies. However, it also reveals how disjointed, as well as confusing at times, both discourses still are. Further, given the systematic complexity of creating circular products it is challenging to provide a comprehensive yet practical overview not too overwhelming for designers (and technical partners alike).

The extension is achieved “through the introduction of service loops” such as maintenance or repair (Bocken et al., 2016: 310).

‘Closing resource loops’ refers to the gap “between post-use and production” that occurs in a traditional linear ‘take-make-use-dispose’ model. The post-use gap is closed by the means of either recycling through “mechanical reprocessing” or by “dissipative loss” (Ayres qtd. in Bocken et al., 2016: 311). Here the notion of no waste comes into play in either “technological” or “biological” means respectively. Designing for a technological cycle is suitable for products of services, while the biological cycle is suitable for products of consumption.

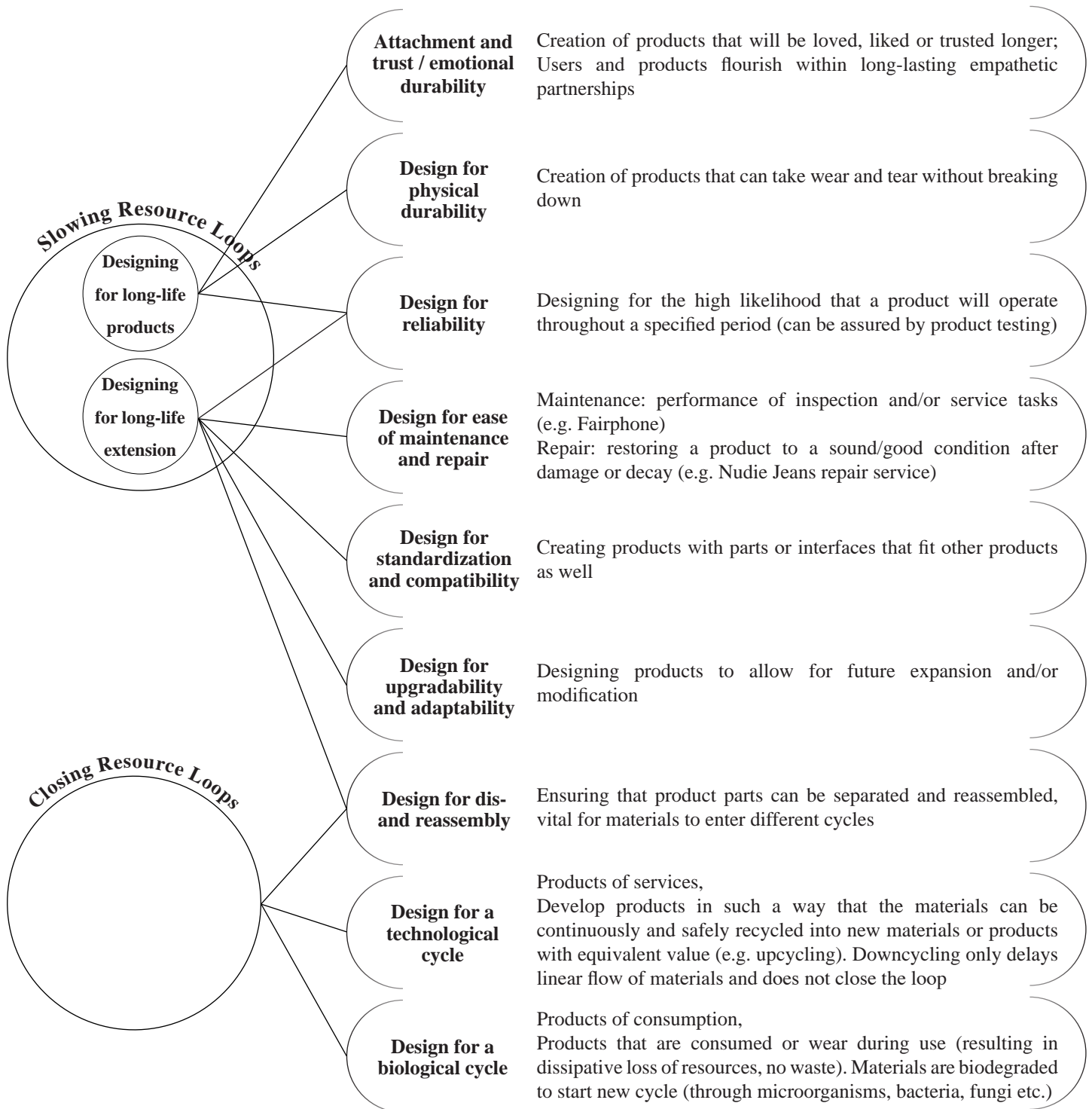


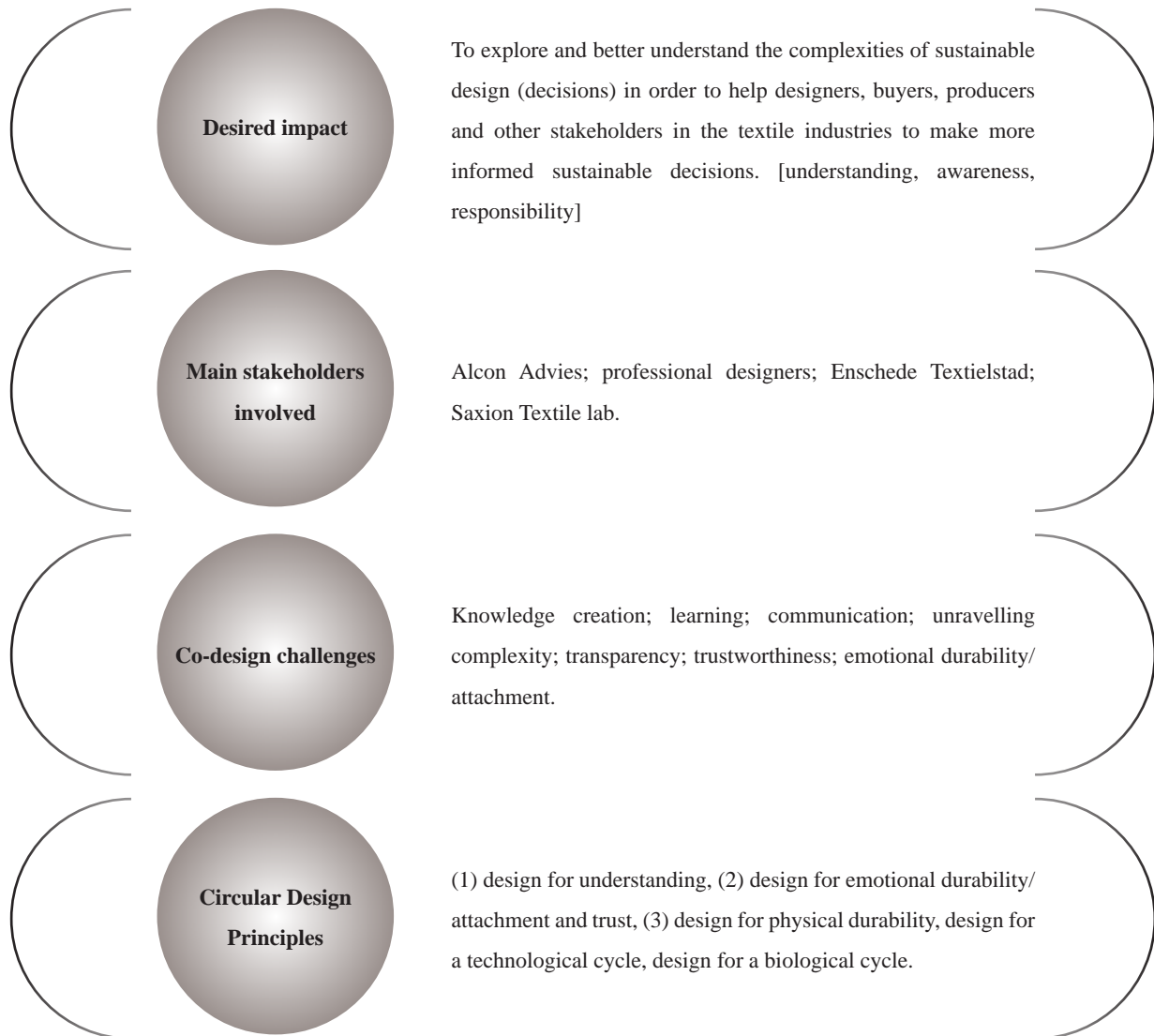
Fig. 5: Based on: Bocken, Nancy M. P., et al. (2016). ‘Product Design and Business Model Strategies for a Circular Economy’. *Journal of Industrial and Production Engineering*, vol. 33, no. 5, 308–320.

Bocken et al. (2016) further indicate a third overarching strategy which is referred to as 'narrowing resource loops'. This particular strategy aims at decreasing the resources used per individual product which has already been successfully implemented in linear production models. While this strategy helps improve efficient use of resources it does not address the "cycling of goods", i.e., resources are not looped back into the system and waste is inevitable. Therefore, narrowing resource loops strategies are rendered less relevant in the context of (GC)². Nevertheless, narrowing resource loops strategies may be implemented in circular models to improve resource efficiency (Bocken et al., 2016: 310).

In regards to further limitations of the framework at hand two aspects need to be mentioned. First, the use of the term resources. Bocken et al. primarily consider material resources which reflects a technocentric perspective. In our forthcoming analysis we specifically extend this limited understanding to also include cultural and social values and dimensions underlying these principles. Second, the term post-use and post-use gap, especially relevant in closing resource loops strategies, lacks clarification. The initial interpretation of waste occurring between post-use and production is usually considered to be post-consumer waste. However, post-use waste occurs at many stages in the production process not only after the consumer/user discards a product. We will adhere to this more nuanced understanding of post-use and post-use gap.

4.2. Case studies

Bureau Baggerman (Michelle Baggerman)



Unravelling Complexity

Baggerman's research within the project (GC)² focused on the exploration of what it takes to create a sustainable product. This was undertaken by exploring the example of a relatively "simple" and "functional" product: a tea towel. By "unravelling" the tea towel and subsequently re-designing/re-engineering it she developed a 'decision matrix' that illustrates the choices that designers and product developers are confronted with in the process: from selecting raw materials and yarn thickness to the density of the fabric and the type of weave, and how these decisions do not only affect the outcome but also each other. This decision matrix thus serves as a communication tool to facilitate better understanding of the complexity of production for designers, producers and users alike. Several tea towel prototypes were produced from this choice matrix to show different "degrees of sustainability" and how decisions taken during the design and production process influence the end product.

Circular design principles in practice: about subconscious decisions and boundary objects as learning devices

Baggerman has indicated the relevance of several circular design principles, including design for emotional durability/attachment & trust, design for physical durability, design for a technological cycle and design for a biological cycle. However, she felt that the essence of her approach is not captured in the framework provided by Bocken et al. (2016), coining a new circular design principle: 'design for understanding'.

As a circular design principle 'design for understanding' revolves around challenges in the complexity of sustainable production and a lack of transparency. The key focus lays on opening up and communicating the complexity of technical and design choices that inform and structure the production process. Design for understanding does not necessarily involve the production of a market-ready end-product. Baggerman's choice matrix and tea towel samples serve as boundary objects (cf. Stompff, 2020; Stompff & Smulders, 2013) to facilitate learning experiences. As she explains, "I am not designing a tea towel really to dry dishes. I definitely design as a way to learn. That it would be much more about learning and about showing alternatives."

By opening up the design and production process to all actors within the value chain (designers, suppliers, manufacturer, users, etc.), complexity is no longer a black box but becomes part of a shared learning process about (technical) limitations and possibilities. Being able to make informed decisions means being able to design for physical durability and for technological/biological cycles more effectively by choosing the right material and production techniques. Further, from transparency and information follows trust according to Baggerman. Design for understanding is thus (ideally) causally connected to design for emotional durability/attachment & trust, design for a technological/biological cycle and to design for physical durability.

Because the communication of the design process alone does not consequently ensure a trustworthy product nor a product that is suitable for a technological/biological cycle, design for understanding cannot be considered a circular design principle in terms of directly slowing down or closing resource loops. However, design for understanding indeed serves as an underlying principle to contribute to circularity as it addresses fundamental issues of sustainable fashion and textile production on a more conceptual and systems level. Understanding as the main driving principle creates knowledge about the design process and can thus open up possibilities for innovation and the development of concrete circular solutions, while allowing for accountability.

As an experienced (sustainable) designer/design researcher, Baggerman applies circular design principles very intuitively. These principles subconsciously guide her initial approach and process. Stable throughout the whole process, they seem to already be part of her essential design ethos. Making the circular design principles explicit by prioritizing them in an exercise, functioned as a thought-provoking tool to reflect on Baggerman's initial approach and validated her way of thinking. Circular design principles thus seem to be especially helpful as a communication and learning tool in the early stages of the design process. In later stages of the project, Baggerman feels there is less room for adjustment or change. As she states, "a bit further into the project it is already kind of set, the puzzle has already been put together in a specific way."

DESIGN PRACTICES

GC(2)

DESIGN FOR
UNDERSTANDING

Opening up and
communicating the complexities
of sustainable fashion and textile
production, creating
transparency



Fig. 6: Exploration and unravelling of a tea towel.
© Bureau Baggerman

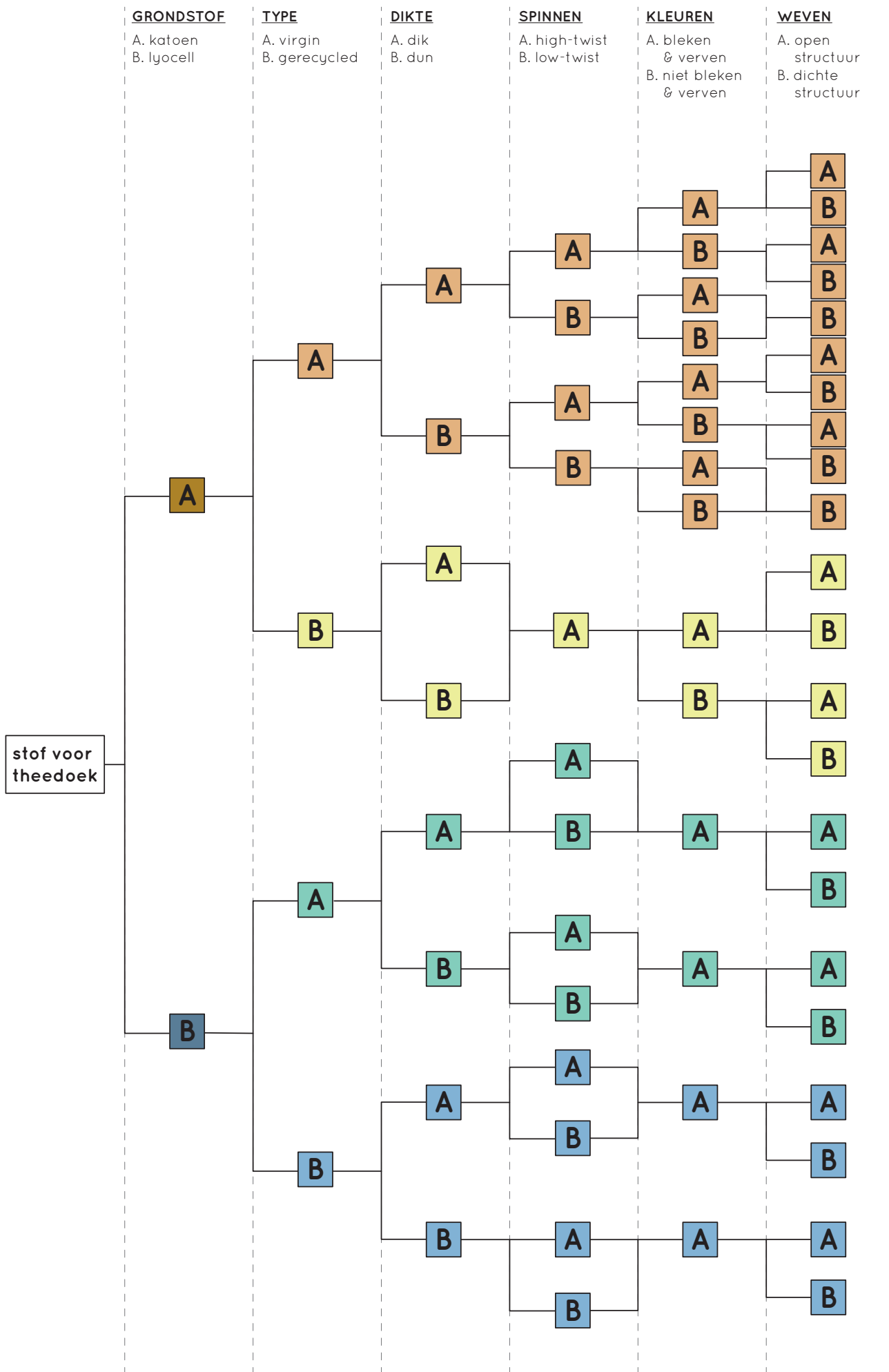
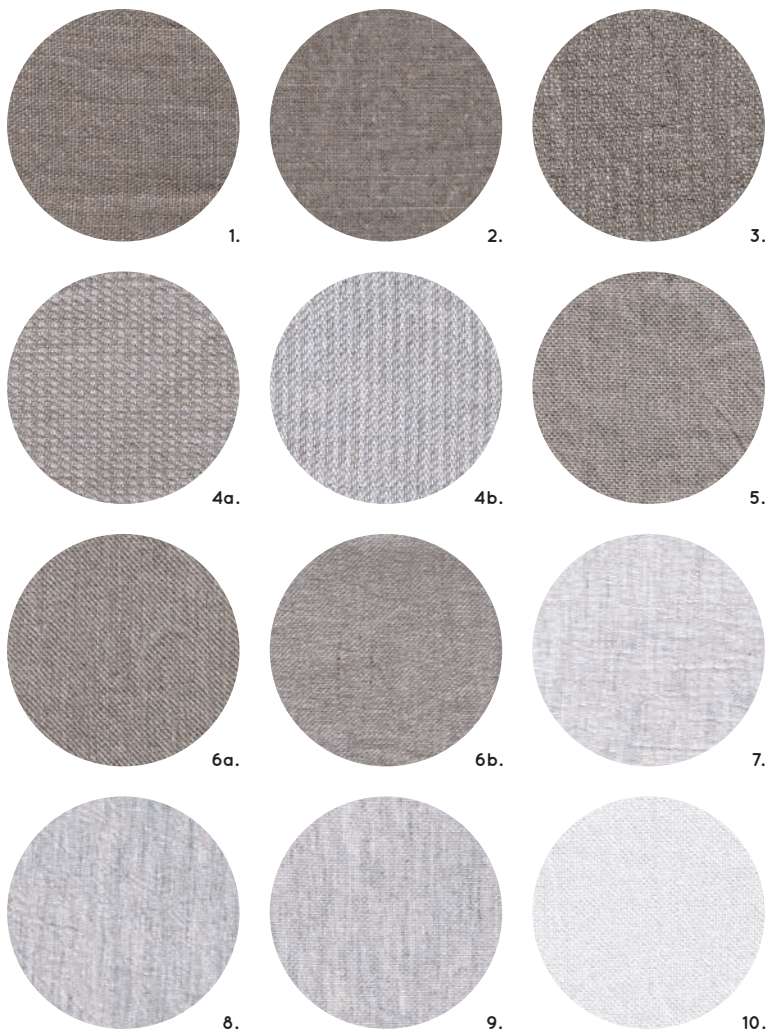


Fig. 7: Decision matrix
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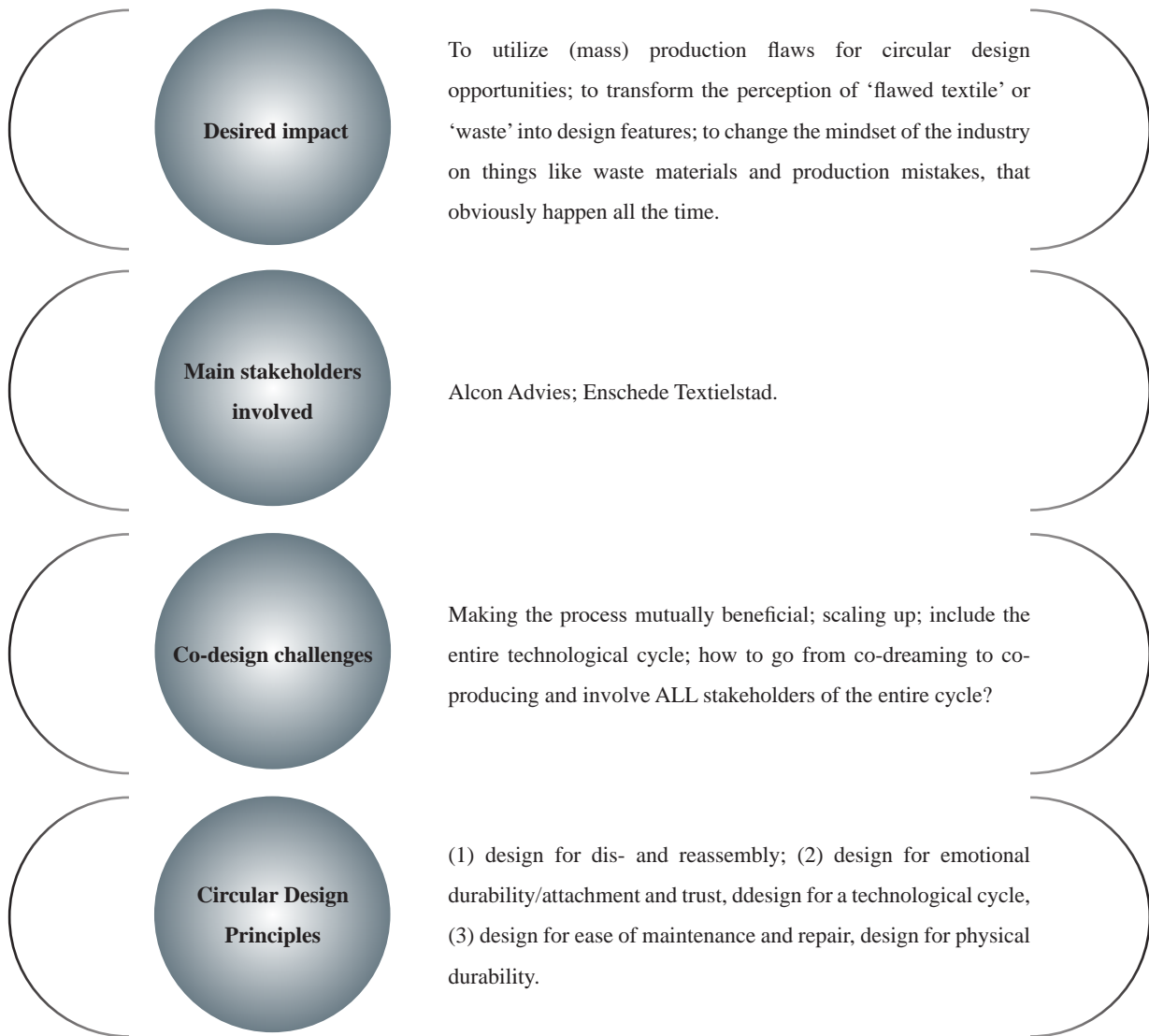


bureau
baggerman & Enschede Textielstad

Fig. 8: Overview fabric of tea towel prototypes who show different “degrees of sustainability”
© Bureau Baggerman



Fig. 9: Overview tea towel prototypes who show different “degrees of sustainability”
© Bureau Baggerman



Upcycling 'flawed' pre-consumer (waste) textiles into modular garments

Hellen van Rees' research focused on working with errors in traditional textile productions. In her collections Van Rees already works with overstock and waste fabrics as well as yarns. This is extended during her time in the project. Her attention to individuality and uniqueness shines through in her personal view on what is traditionally understood as irregularities or 'flaws' during production; textile production irregularities and 'flaws' are approached as possible "gems for design ateliers". She explored the possibility to repurpose this form of textile waste by utilizing it for small-scale productions or limited series products or collections. In the process she developed three samples for a small collection with modular garment parts.

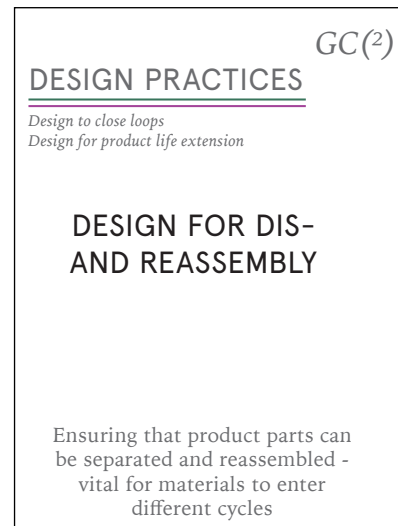
Circular design principles in practice: creating emotional bonds through the interplay between design approach and business model

Van Rees' approach and respective design process touches upon several circular design principles with the most prominent being: design for emotional durability/attachment and trust, design for dis- and reassembly, design for a technological cycle and design for ease of maintenance and repair.

Van Rees started the project by focusing on technical errors in textile production mainly addressed by the principle 'design for a technological cycle'. In close collaboration with Annemieke Koster from Enschede Textielstad, she assembled an inventory of common production 'mistakes' and 'errors' that usually end up as waste in landfills. She reframed the perception of those waste textiles and scraps by reworking/upcycling them into new products and unique details. Value is added by repurposing them for high quality garment design enabling the waste to be looped back into the system and thus a (more) circular flow of material resources. Deemed the most important circular design strategy in the beginning, it turned out to be less important in later project stages. Van Rees perceives the whole technological cycle as "too abstract" which draws attention to the real-life complexity of textile production and how difficult it is for a designer (or any other single stakeholder in the value chain) to oversee the entire process.

She stressed that her general design and business practice within as well as outside of the (GC)² project involves establishing a "very close relationship with her clients". Her products are specifically made according to the client's individual needs and wishes (e.g., made-to-measure, specific body measurements). She views the uniqueness and individual features of the reworked waste textiles as design elements that help to create a unique and personal product identity and thus help to facilitate greater emotional attachment to the product. Personalization of garments, the personal connection built through the buying process and the use of unique fabrics in the form of upcycled textile waste thus contribute to enhance emotional durability, to ensure a long product life-span and to slow down resource loops.

While her initial approach was to focus on reworking textile waste fabrics the project developed into much more than Van Rees would have imagined in the beginning. Through the interaction and technical knowledge exchanged with Annemieke Koster as well as Anton Luiken from Alcon Advies, she realized she has to take further steps and extend her initial approach to truly be able to develop a circular product. Throughout the project the principle 'design for dis- and reassembly' has gained in importance. As she explains, "designing the garments in a way that they can be dis- and reassembled in parts, and then other parts can be reused, and the parts that are not working or are broken, they can be recycled. That's something I didn't think about before starting [this project]." To facilitate dis- and reassembly as well as ease of maintenance and repair Van Rees developed a small collection with modular garment parts. Garment parts can be assembled into various versions as well as taken apart and replaced if damaged or not liked/wanted anymore. All pieces are attached with a yarn that can be melted for easy disassembly.¹⁰



¹⁰ <https://wear2.com/en/products/wear2-thread/>

What stands out in Van Rees' case is the interdependency between her design approach and business model. Developing a circular product does not stop at implementing technical solutions. Developing a circular business model to establish a close connection with the user and to support the replacement or repair of garment parts is crucial to slow down and close resources loops. Otherwise, technical solutions (i.e., reworked waste textiles) are not able to enter a new cycle. It also suggests that emotional durability cannot solely be achieved through design but more importantly needs to be facilitated/supported through a business model that centers around establishing meaningful social connection/relationships.

Van Rees usually does not work with circular design principles on a conscious level although they clearly are part of her design ethos, subconsciously guiding her design approach and practice. Trained as what she refers to as a "traditional" designer, neither the concept of circularity nor respective design principles were part of her education. Her sense for sustainability was refined mostly after her studies when she realized the importance of societal and environmental influences. "In my education it was really about design, aesthetics and finding your own signature and creative process (...) afterwards it becomes a business and it becomes a combination of creative processes and the world around, where it has to land basically", she explains. The project context of (GC)² has enabled her to work with circular design principles more consciously and to use the principles as a tool for reflection and refining her process: "my new designs are informed by these kinds of principles actually". The project context has added an additional layer by allowing her to dig deeper into technical issues in combination with certain principles, e.g., design for dis- and reassembly. Collaboration/Co-design within the project facilitated sharpening and adjusting her initial vision, her process and to implement concrete circular solutions.

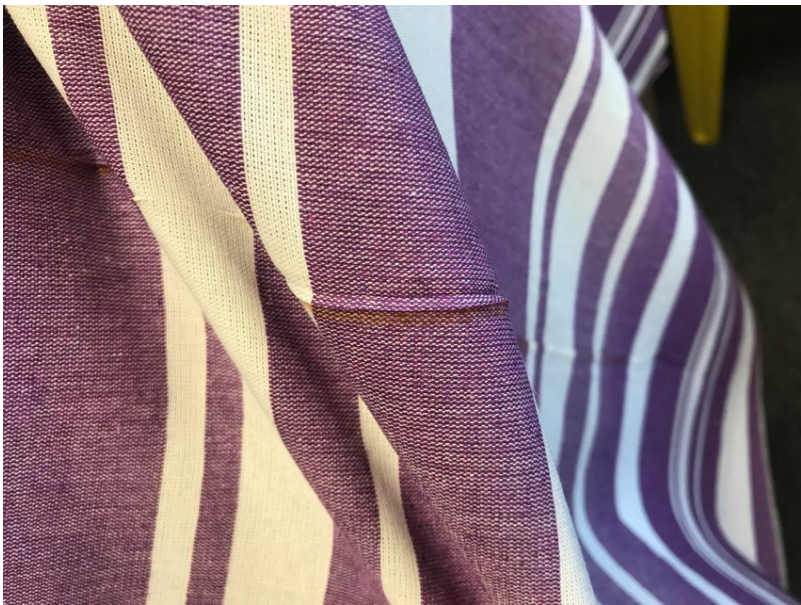
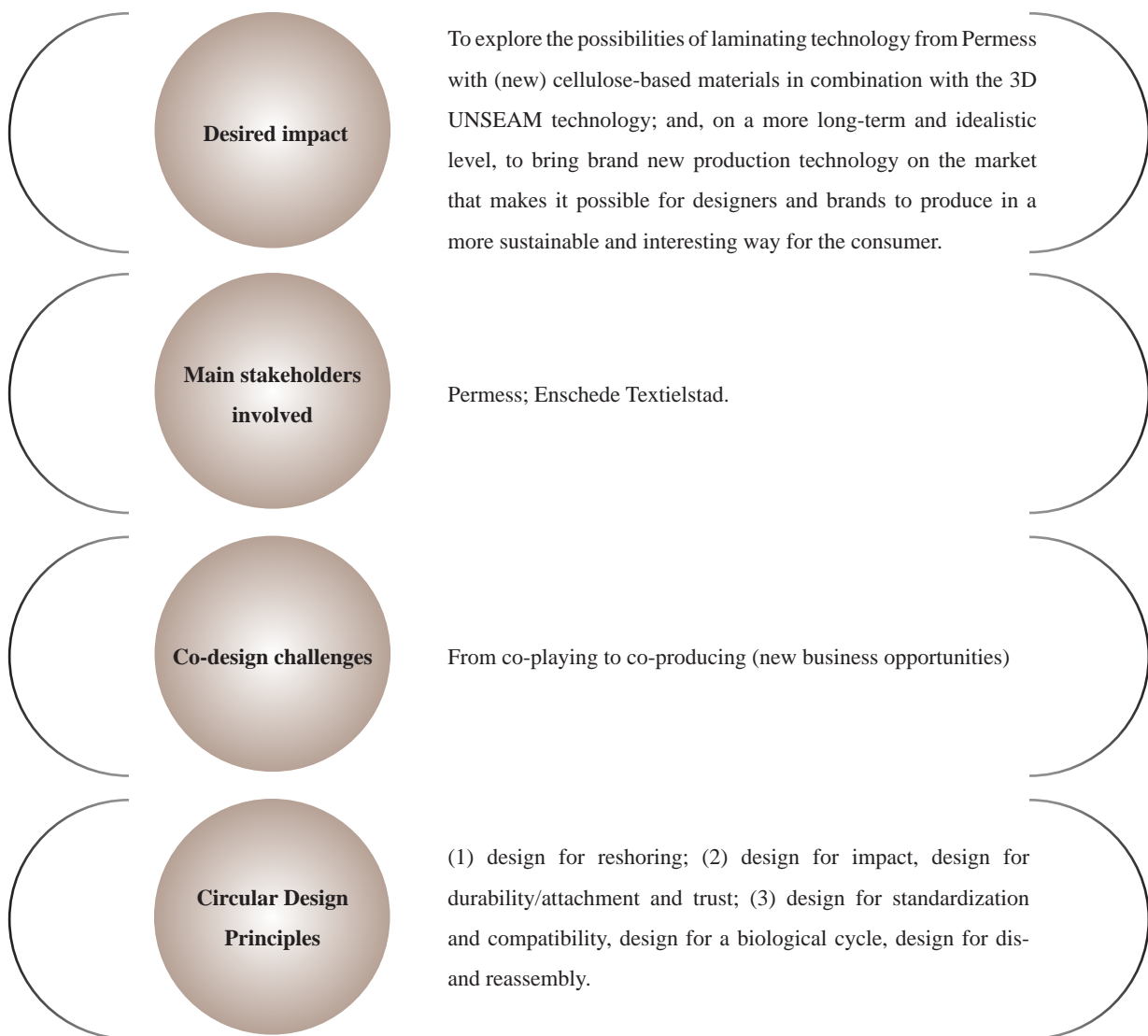


Fig. 10: Fabrics with 'flaws' or irregularities Van Rees works with
© Hellen van Rees



Fig. 11: Samples of a small collection with modular garment parts
© Hellen van Rees



3D textile shaping with cellulose-based materials

UNSEAM's (Bas Froon & Karin Vlug) research within the (GC)² project focused on furthering their development of 3D shaping textile technologies based on laser cutting, laminating and heat fusing. By cutting out the labor-intensive production step of seaming, they aspire to make production possible in the Netherlands closer to the user and on-demand – tackling issues of overproduction and globally fragmented untransparent production networks contributing to labor and resource exploitation. In collaboration with Permess and Enschede Textielstad they explored if their “UNSEAM 3D shaping process also works with (partly) cellulose-based textiles” and sustainable laminating processes including biodegradable glue. UNSEAM is developing a process and production technology; the product is secondary to their approach.

Circular design principles in practice: Re-designing local and transparent production processes

UNSEAM's approach is guided by several circular design principles the most relevant being: design for reshoring, design for emotional durability/attachment & trust, design for a biological cycle (and design for impact).

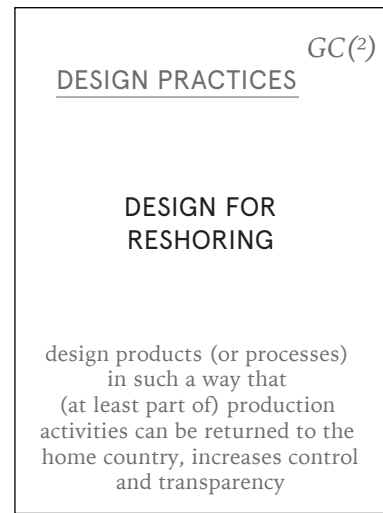
'Design for reshoring' (a principle not included in the theoretical framework of Bocken et al. (2016)) is commonly referred to design products (or processes) in such a way that (at least part of) production activities can be returned to the "home country of the parent firm regardless of ownership of the relocated activities" (Ellram et al., 2013; Gray et al., 2013 qtd. in Robinson & Hsieh, 2016). In the case of UNSEAM, design for reshoring is fundamentally

concerned with the design of a production process (and business model) paying close attention to locality; the product itself is secondary. This increases control and transparency over production activities by an increased oversight of human labor as well as raw material resources. Design for reshoring does not automatically address the speed of the cycling of resources, but can be considered a 'narrowing resource loop' principle. As Froon explains, "(...) you can have shorter loops between consumer, manufacturer, shops, et cetera." by producing on-demand and locating production activities closer to the user. In this way reshoring can also increase the agility of supply networks; less stock is necessary and reaction times to changing demand can be shortened considerably tackling the discrepancy between (over)supply and demand.

For UNSEAM, design for reshoring interweaves with design for emotional durability/attachment & trust: "We're developing technology to make it functional but also that it looks really cool. (...) that sound superficial, but it's also about quality. If you make a textile product and it does not tear apart, then it looks better and feels better, the quality is better in general." What Froon points out, is that trust in a product can be facilitated by its aesthetic qualities, which in turn are directly connected to its technical qualities. Design for reshoring can thus deliver material value as well user value by establishing trust in the actual material quality as well in the perceived quality and authenticity of products ultimately helping to slow down resource loops.

The principle 'design for impact' coined by UNSEAM themselves revolves around issues of hidden costs for society. Costs that are not represented in a product price and that are difficult to measure, such as pollution related to shipping garments, the origin of raw materials or the energy consumed by twisting yarns. By considering and determining these factors with a quick scan LCA before finishing the conceptualization of a product you can have a bigger impact on the circularity of the product. Furthermore, this principle is market sensitive. To make an impact on circularity on a larger (as well as on a small) scale, one needs to consider the market and client for the developed product/process. It is an approach to change the industry from the inside out. Having an impact on the market can speed up the transition towards circularity. While design for impact does not directly address the speed of resource cycling, considering the environmental impact as well as the possible market impact facilitates a more holistic approach towards the production of circular fashion and textiles.

Another important principle addressed within UNSEAM's approach is design for a biological cycle. By introducing experiments with cellulose-based fibers and textiles, they work towards close loop realization. Within their collaboration with Permess, Froon and Vlug experiment with switching conservative glue used in



laminating processes for biodegradable glue. The combination of cellulose-based textiles and biodegradable glue could potentially make their products compostable cutting out waste in the process. However, production steps like coloring or finishing impact the biodegradable qualities of the textiles, making the whole process extremely complex. By working with companies in the Netherlands they try to achieve a high degree of control over fiber and textile sources and production activities.

Froon and Vlug are both experienced designers with clear goals in relation to circularity as the discussion of circular design principles above illustrates. For Froon circularity is generally a difficult concept to work with: “It is a completely meaningless concept in my personal perspective. (...) You need to specify it in real depth for the environment or system you are working with”. His statements support the aspect that the concept of circularity and circular design principles is not new. The difficulty of applying circular design principles lays in developing concrete circular solutions specifically for the field of fashion and textiles. For UNSEAM developing a sense for the general logic behind the principle(s) of circularity is key to becoming a (more) circular designer. Circular design principles thus promise to be especially helpful as educational/learning tool to make the logic behind circularity part of your design ethos and to subconsciously guide your design and decision-making process. Yet, it is in translating these principles into concrete circular solutions for specific clients in the context of a shared problem, that circular design principles become meaningful and feasible.

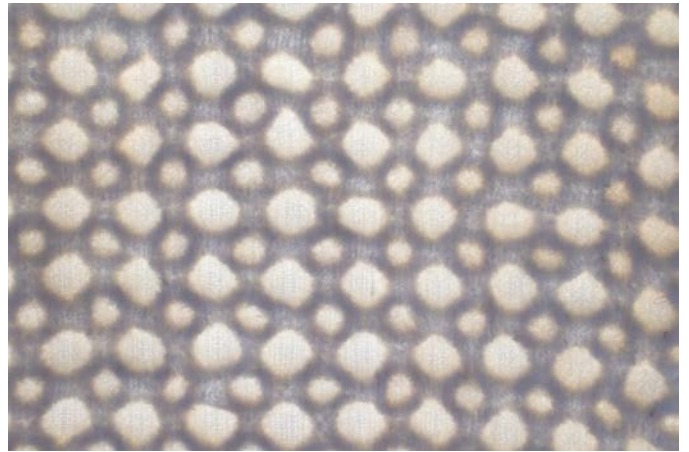
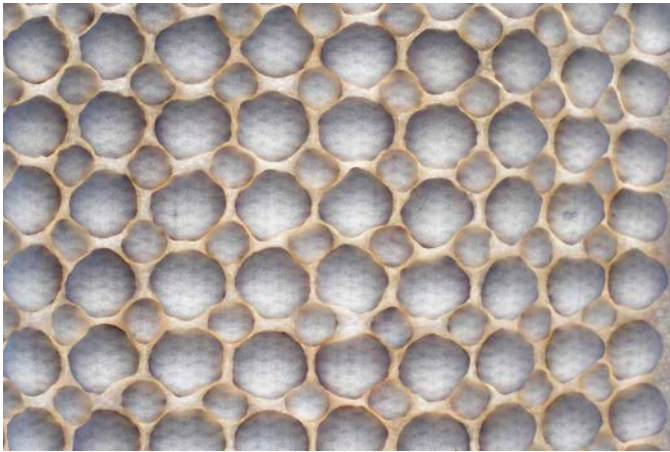
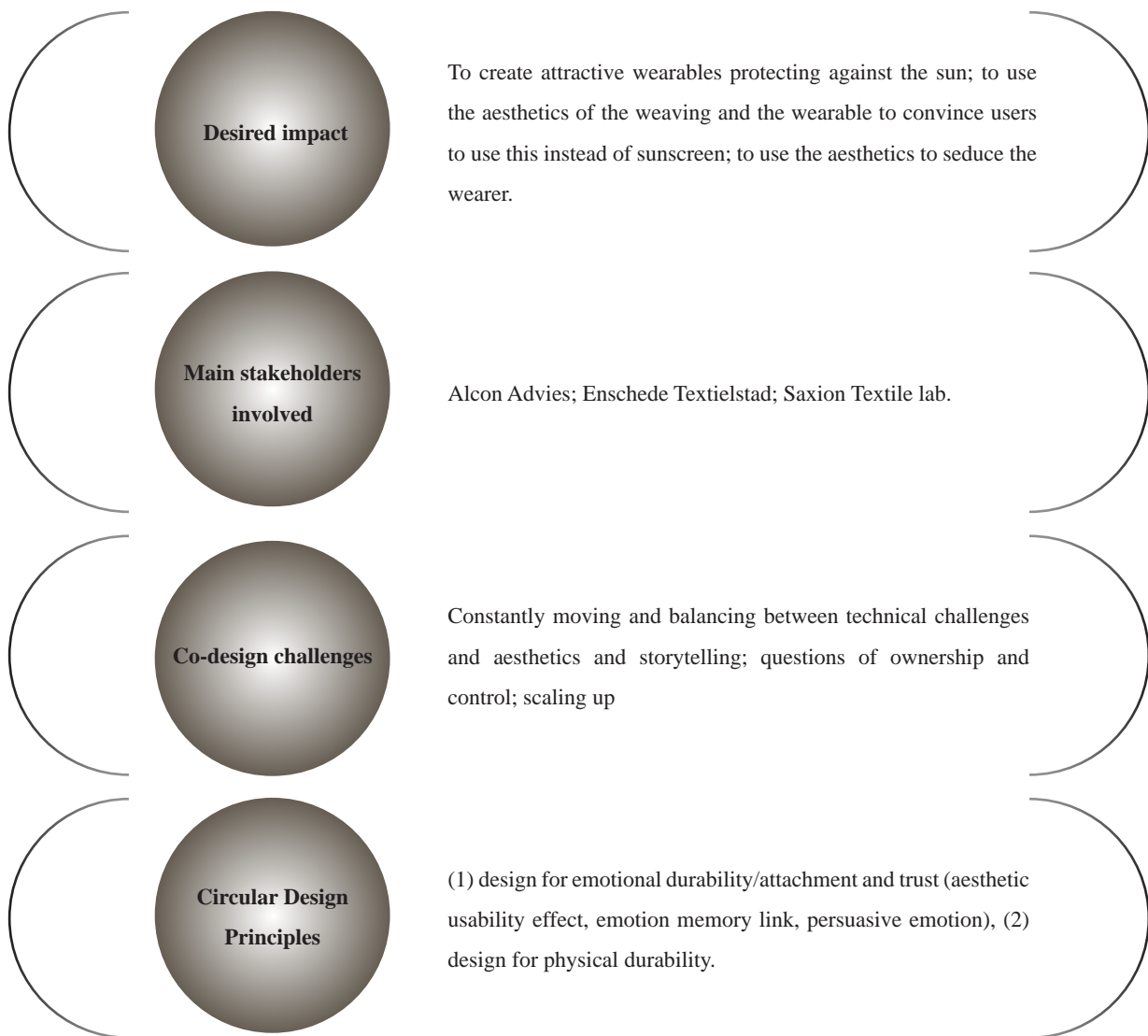


Fig. 12: Examples of 3D shaping textile technologies based on laser cutting, laminating and heat fusing
© UNSEAM



Working *with* the material: cellulose-based textiles to replace sunscreen?

During (GC)² Belén (Brecht Duijf and Lenneke Langenhuijsen) did in-depth research as part of their SUN+ project. Their most important question is: how can we replace sunscreen (SPF) with cellulose-based textiles (UPF)? They worked with natural fibres and explored how different kinds of weaving, the density of the woven textiles, and the thickness of the yarns affect the UPF factor. Together with Saxion and Enschede Textielstad they produced woven textile samples with differences in yarn thickness or openness of the weave assessed on how they influence the UPF value and aesthetics of the fabric. This led to an overview of different combinations for the desired UPF factor. During the process of designing the cloths, they used very few seams and focused on models of cloth that help to circulate air. In addition, they deliberately work with unisex patterns. Belén’s starting point is the material itself; they approach material as an equal partner working together “in collaboration with material”.

Circular design principles in practice: emotional durability facilitated by an interplay of aesthetic and technical qualities

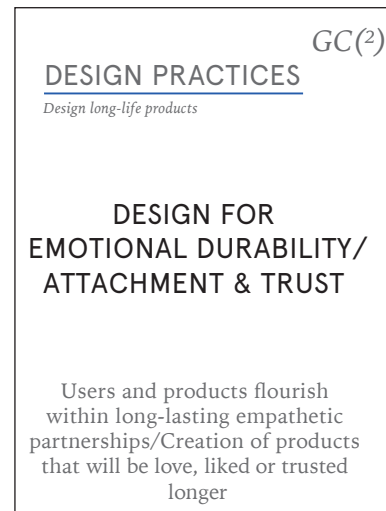
Belén has indicated the relevance of several circular design principles with the most important being: design for emotional durability/attachment and trust and design for physical durability. They utilize several (not directly circular) design concepts/principles to achieve greater attachment to their product ultimately prolonging resource life cycles.

Duijf & Langenhuijsen aim to influence user behavior by utilizing a concept referred to as the ‘Aesthetic Usability Effect’: “apparent usability is strongly affected by the aesthetic aspects rather than the inherent usability” (Kurosu & Kashimura, 1995). In other words, products are perceived more usable than they inherently are if aesthetically pleasing - a paradoxical concept observed in interface and UX design.¹¹ The designers use this to their advantage to encourage (more) circular behavior. By offering an “aesthetically pleasing experience [we] empower usability and increase the user’s willingness to learn and adapt”, as they state. To assess the actual impact of Belén’s approach, meaning in how far aesthetics qualities of fashion and textiles relate to increased (perceived) usability, would require additional user analysis.

Apart from increasing (perceived) usability, the aesthetic qualities of the weave and wearable (for instance their use of color indicating the UPF value) are utilized to create and enhance a personal emotional connection between user and product. Belén refers to this as ‘Emotion Memory Link’ and ‘Persuasive Emotion’, “the aesthetic choices made by the designer serve as a catalyst for positive change in the way users [emotionally] interact with the product” (De Brouwer, 2020). In Belén’s view, an emotional bond can also lead to an increased sense of ownership. As the designers explain, “users place more value in experiences where they feel a sense of personalized ownership, as if the experience/product is an extension of themselves”. By highlighting the importance of aesthetic qualities in establishing an emotional connection between material and the user to achieve more circular behavior, Belén’s approach also closely relates to Kristine Harper’s concept of ‘Aesthetic Sustainability’.

Another principle Belén addresses is design for physical durability. The use of cellulose-based hemp yarn extends the physical lifetime of their wearables. Locally sourced hemp fibers are able to take wear and tear without breaking down. In the case of Belén, physical durability and emotional durability come in tandem. Traces of use alter the aesthetics qualities of the product through time – through use it becomes alive. Through the use of physically durable fibers/yarns the product is able to live and evolve with the user growing a long-lasting emotional bond over time.

Duijf & Langenhuijsen have a very clear vision about their design practice and the principles that inform their process. (Circular) design principles seem to guide them subconsciously as part of a vision and practice that is developed through time and experience. While they do not refer to them concretely, they are part of Belén’s fundamental understanding of how to approach design. As Langenhuijsen states, “it is in our genes. It is in our ethos. I think we are aware of it all the time.”



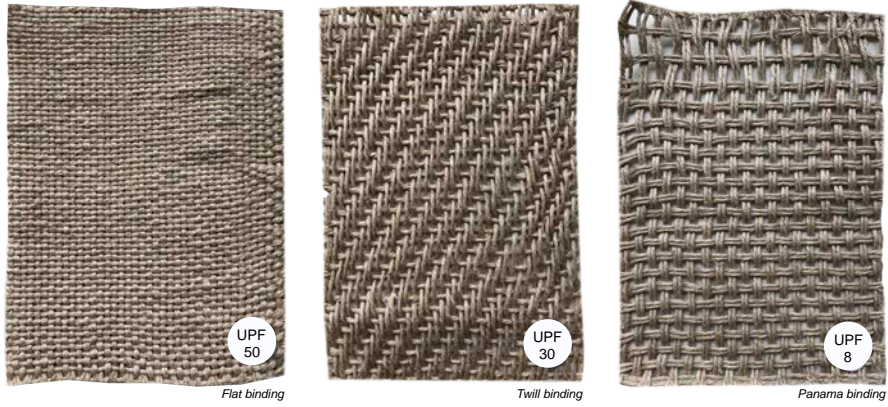
¹¹ Although commonly referred to in systems and interface design, it is contested. For a contesting view on the effects of aesthetics on perceived usability see for instance: Grishin, John. “Exploring the Boundary Conditions of the Effect of Aesthetics on Perceived Usability.” (2018).



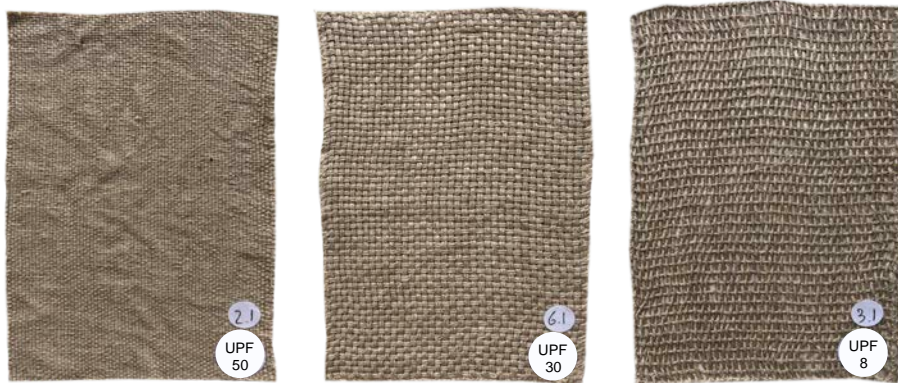
Fig. 13: Examples of wearables UPF 8 and UPF 20

© Buro Belén

DIFFERENT WEAVINGS



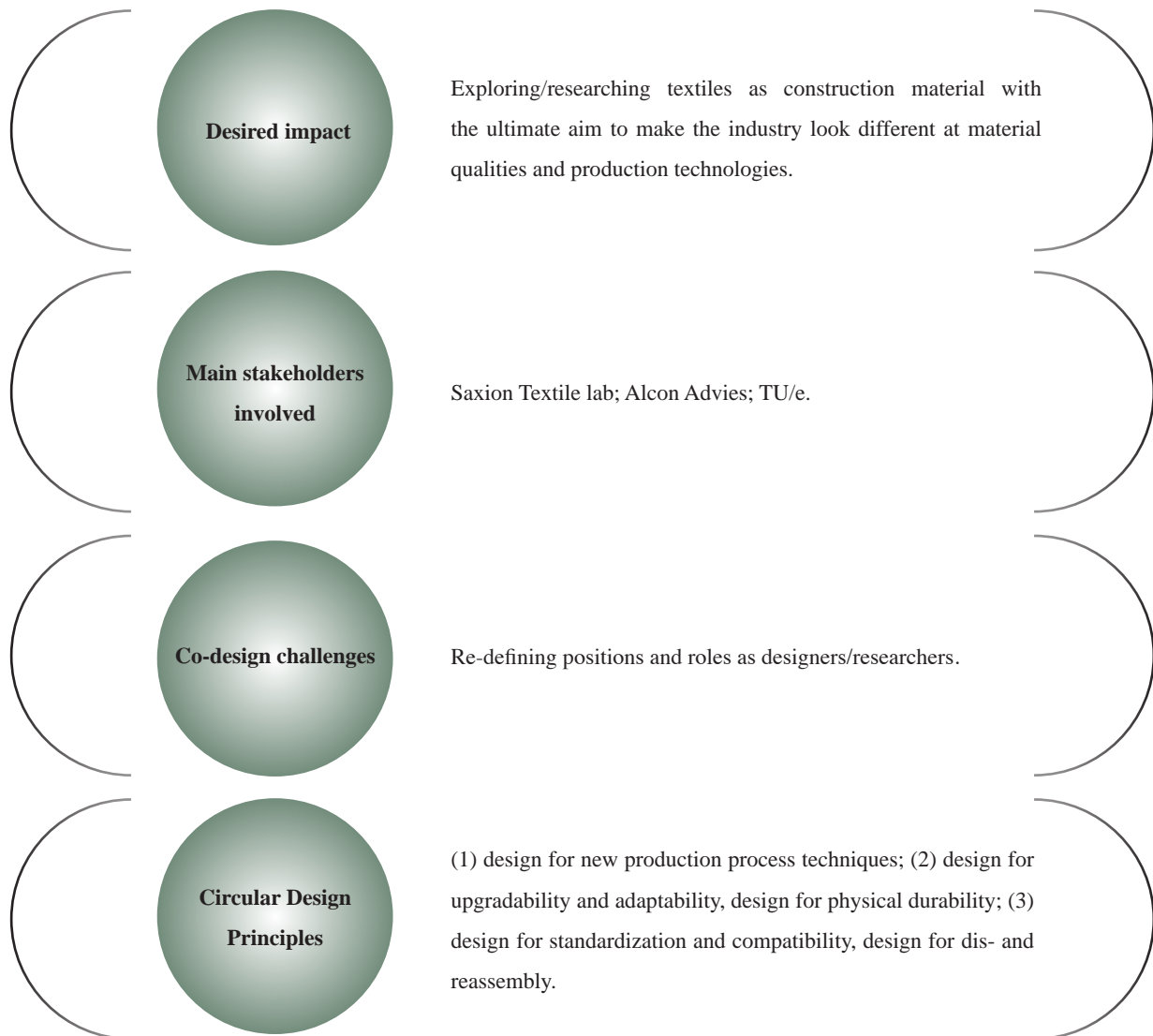
WEAVE DENSITY



THICKNESS YARN



Fig. 14: Examples of woven textile samples with different yarn thickness or openness in the weave
© Buro Belén



Weaving 3D textiles by experimenting with yarn properties and bindings

Milou Voorwinden and Suzanne Oude Hengel are a technically oriented textile design duo specialized in knitting as well as weaving. Central to their practice is what they refer to as “investigative experimentation” meaning that material experiments combined with deep technical knowledge guide their design process. This approach involves openness to unexpected results and embracing ‘mistakes’ to “push the boundaries” of current textile production. Within (GC)² the duo focused on working with primarily cellulose-based yarns (paper, hemp and linen) by researching and experimenting with the yarns’ technical properties such as “shrinkage, stiffness and elongation” and how these properties can be used to create 3D woven textiles. In the process they developed a novel production and weaving technique that creates 3D shapes by incorporating folding lines. The textile folds are created through woven binding structures and the experimental use of yarn properties. In cooperation with Saxion, TU/e and Alcon Advies, they developed a range of 3D textile samples based on their experimental use of different weaving looms, the created weaving structures and yarn properties.

Circular design principles in practice: Pushing the boundaries of current textile production techniques

The design duo has indicated the relevance of one design principle in particular: ‘design for new production process techniques’. Not part of the theoretical framework provided by Bocken et al. (2016), this principle involves pushing the boundaries and opening up traditional textile production techniques by focusing on the process itself; the product is secondary.

With their research the designers explore possibilities of current textile production, as Voorwinden explains: “(...) there is so much more possible than what is happening now on looms and knitting machines. So much is based on how we used to make fabric. I want to open that up.” For them, it is not about developing new machinery but about using traditional production techniques and applying them in new and unexpected ways. For the application of this design principle extensive technical knowledge of the weaving looms (e.g., how the tension on the loom influences woven structures), weave bindings and yarn properties is needed. This case study illustrates that technical properties influence the design heavily and how intertwined technical and aesthetic design in fact are.

With their technical and process-oriented approach, Oude Hengel and Voorwinden bare similarities to the approach of UNSEAM. UNSEAM is more radical in their approach by also including the development of new machinery and using innovative digital techniques such as laser-cutting, while Oude Hengel and Voorwinden strive to change the outlook on and limits of already existing and traditional machinery and techniques.

‘Design for new production process techniques’ as a principle is not circular in the sense of directly slowing down or closing resource loops. While it can (but does not have to) be used for circular goals, the subsequent application of the technique determines if the principle becomes circular or not. Circular examples could be weaving a product in one piece from a mono-material cutting out additional production steps and making it more suitable for recycling thus narrowing and slowing down resource loops simultaneously. The design principle is circular in the sense that it changes and opens up mindsets and challenges traditional ways of working, as it “forces the designer to question sourcing methods, challenge production methods and apply multidisciplinary thinking in which the role of the designer is challenged” (De Brouwer, 2020).

Initially Oude Hengel and Voorwinden intended to apply their newly developed technique to a product. Throughout the process the designers had to adjust their initial approach as material experiments and development of technique required much more time than anticipated. The project context and the reflective use of circular design principles encouraged them to question and refine their approach. Their value proposition seemed to have changed from developing products to developing knowledge. They seem to be subconsciously aware of design principles as part of their design ethos. The project context and conscious reflection on the design principles thus proved a helpful tool to question their role, reevaluating their approach and positioning within the textiles and fashion system and to make circularity part of the designers’ agenda

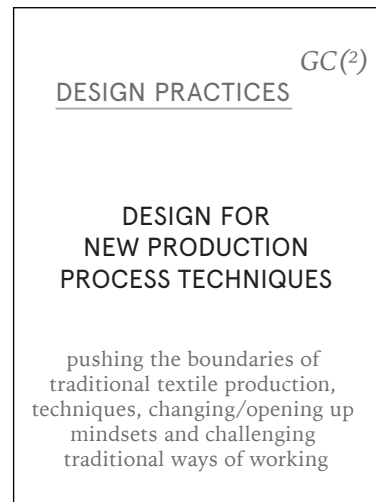
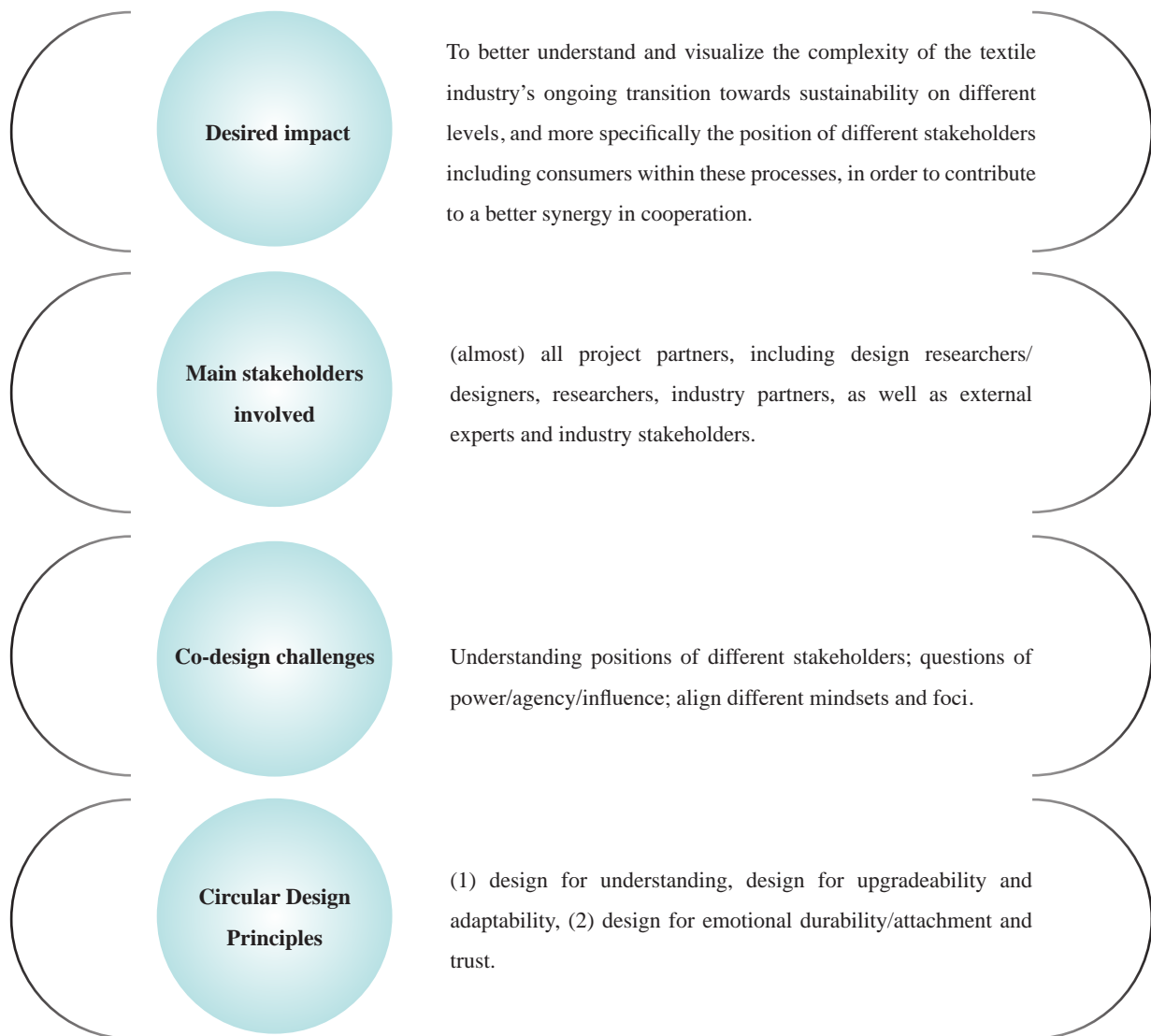




Fig. 15: Examples of weaving technique that creates 3D shapes by incorporating folding lines.

© Suzanne Oude Hengel & Milou Voorwinden



In search for alternative (business) models for fashion and textiles

Els Bugter took quite a different approach compared to the other designers involved in (GC)². Her approach was more conceptual researching the larger system and industry that is fashion and textiles with a special focus on business models and the position of the consumer and other stakeholders. Her starting point was to dive into sustainability initiatives currently existing in the industry. She grappled with questions of ownership, post-consumer design, the role of the consumer, different forms of capital (financial and environmental/natural), and finding alternative (business) models for circularity and sustainability. By interviewing industry experts, including the (GC)² designers and technical partners, Bugter developed an infographic to map current industry initiatives, showing different types of capital involved and to position them in the industry alongside other stakeholders. She further documented her interviews in a podcast series.

Circular design principles in practice: Developing tools to connect, communicate and understand a complex changing system

Bugter's approach touches upon several circular design principles. She has indicated the relevance of design for upgradeability and design for emotional durability. Most importantly her approach involved the use of the principle 'design for understanding'.

Design for understanding was coined by Michelle Baggerman throughout the process of (GC)². Similar to Baggerman Bugter tackled issues of complexity. While Baggerman focused on the complexity of technical and design choices informing the production process, Bugter zoomed out to the larger industry structure as a whole. Her developed infographics serve as communication tool

for her and for others to get a grip on the complexity of the industry and the stakeholders involved. Using her infographics as communication tool within her interviews she connected and communicated between different perspectives. Trust, transparency and putting natural capital center stage played a crucial part in her approach. Design for understanding in the case of Bugter involved creating a tool that fosters understanding and facilitates a learning experience to understand the system and structure of the fashion and textile industry at large. With increased understanding of the industry structure and what forms of capital drive different stakeholders it becomes easier to imagine alternative (business) models that promote circularity.

Bugter referred to design for upgradeability and adaptability as her main guiding principle. In Bocken et al.'s (2016) understanding the principle is product-focused, describing the design of products in such a way that they allow for future expansion and/or modification. Bugter applied upgradeability and adaptability not on a product but on a system level. To her it refers to a shared collective "urge and awareness for change", a shared mindset with the urge to upgrade and adapt the current system.

Within her conceptual approach Bugter connected design for emotional durability to her research into different forms of capital. She argues that there is a dire need to shift from the centeredness of financial capital to natural capital and environmental profit. How can natural capital be factored in in the current fashion system? In her view emotional attachment, trust and durability is the facilitator of such transition: "I think [it] has to do with the whole industry, (it) has to re-set from linear to circular - to shift from the financial profit and loss to natural capital - environmental profit and loss. And that is really quite a change. The emotional durability is a carrier for that - the connecting thing".

While none of Bugter's use of the principles directly slow down or close material resource loops, the circularity lies in creating a different mindset and new knowledge about the system. Thus, opening up possibilities for innovation, imagining and implementing alternative (business) models and the development of concrete circular solutions.

In comparison to the predecessor project GEGD, Bugter's focus shifted from designing goods to researching the bigger picture. By switching roles, she questioned and reevaluated her own position within the system that is fashion and textiles. Her developed infographics and podcast series were her way of finding new meaning, possible alternative (business) models and her position in a changing industry. Values such as honesty and transparency are part of her design ethos and she seemed to have used circular design principles quite consciously as a way of



constantly reflecting on new ideas, to frame her thinking and to keep focused on her ultimate goal. The principles not only served as a framework to guide her thinking but also a tool for communication, as Bugter explains: “They are framing my view on things. I have to think about the principle, and by thinking about the principle I am framing the principle. (...) And it’s not easy to communicate, but by framing, by thinking about it (it) will be easier to communicate.”

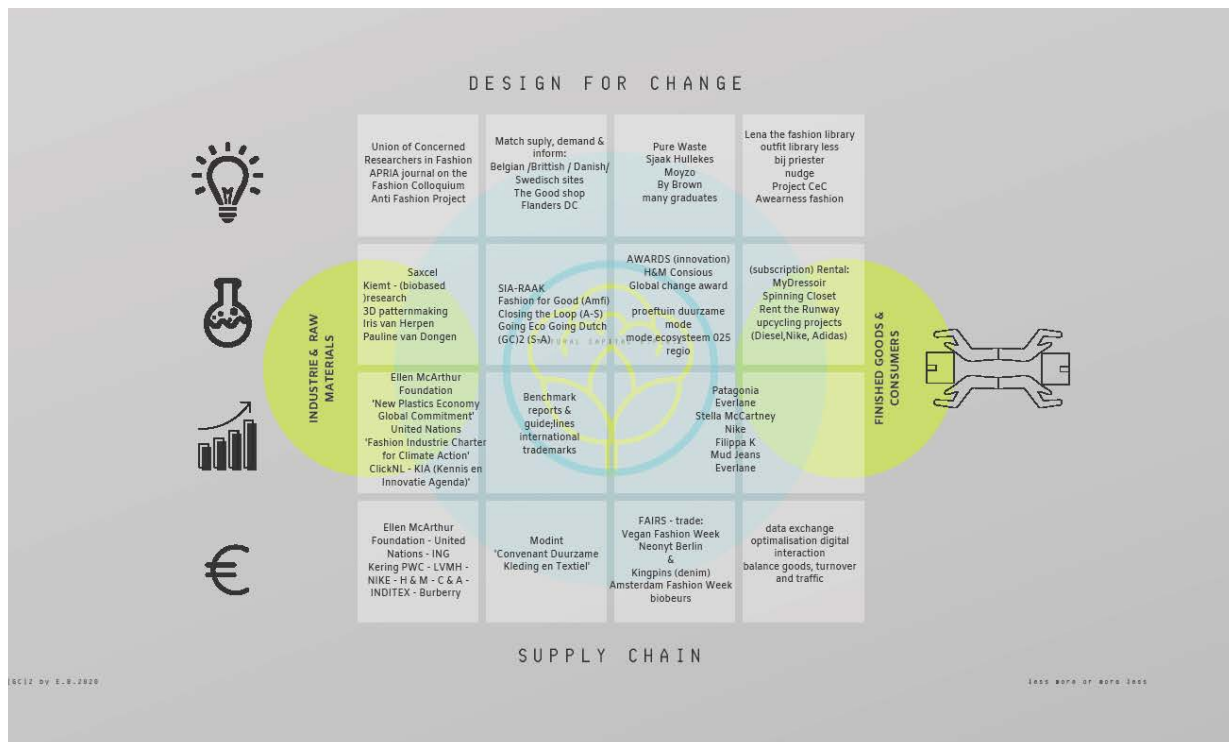


Fig. 16: Model from supply chain regarding product development to systemic change and value creation
© Els Bugter

4.3. Circular design principles in practice

These case studies have shown how the designers have put several circular design principles in practice and offer examples of concrete methods and strategies on how to do so. The principles have proven helpful as a learning tool, especially in the beginning of the design process, and as a way of broadening the horizon of the designers and opening up the possibility to explore and reflect on principles that were not already part of their design ethos. In the next chapter we will further discuss the experiences and practices of co-design and co-creation in different contexts.

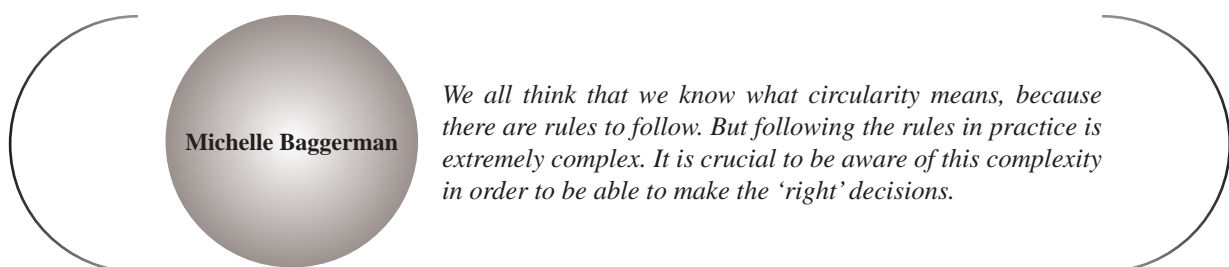
5. Co-design for circularity

As we have seen in the previous chapter, circular design principles can help designers to reflect on their role in designing for circularity, both by themselves and in interaction with other stakeholders. However, we have also seen that putting these principles into practice is not just a matter of following a recipe, as they do not work in isolation. Translating circular design principles into concrete strategies and products is an iterative and collaborative process that depends on the efforts of all stakeholders involved. Circular design thus is a joint effort, which relates to our exploration of co-creation in chapter 3. We learned that the value of co-design and co-creation processes is highly context-dependent. The designers and design duo's within (GC)² might share similar values regarding sustainability and circularity, but their design approaches, knowledge and expertise, as well as ways of working can be very different. In this chapter we will therefore dive deeper into the experiences and practices of co-design and co-creation in different contexts. In this way we aim to understand how different circular design principles can benefit from a collaborative mindset and a co-creative process and what it means for the role of designers within this process.

Although each of the six designers and/or design duo's explored different questions each in their own unique context, as described in the previous chapter, we were able to synthesize the designers' practices into three co-design focus areas in which circular design principles are put into practice. Each area sheds a different light on the complexity of circularity as well as on what makes co-design valuable and needed and what makes it challenging from the designers' perspectives. These are: 1) co-design for understanding, 2) co-design for use(r) value, and 3) co-design for material and process innovation. We will discuss each focus area by reflecting on the different experiences and practices within two design research case studies. This does not imply that each designer or design duo works only within one area. The different co-design focus areas are all interrelated, partly overlap, and can become more or less important depending on the context and the phase of the design research. But the case studies help to illustrate that there are different positions and starting points that designers can take when dealing with circular design principles in a co-creative process.

5.1. Co-design for understanding

While complexity might be seen as an obstacle, designers Michelle Baggerman (Bureau Baggerman) and Els Bugter (tous les chéris) actually see it as an opportunity to use their competencies to address this complexity in novel ways. Both their design research projects start with asking why: why is it so difficult to design and make truly sustainable products? And why is it so difficult to collaborate?



Baggerman and Bugter both identified a combination of technical, social and cultural circular design principles, and they recognize the principles' interdependencies. But their main starting point in designing for circularity is to co-create knowledge and awareness in order to create transparency, trust, attachment, and emotional durability. Designers' abilities to translate (abstract) knowledge with and for different stakeholders by making it tangible, visual, understandable and usable is key here, but designers can take different approaches to create such understanding and a shared language.

Baggerman starts with the product. By literally unravelling a tea towel, and subsequently unravelling the design and production process and making it visual in the form of a decision-making tree, Baggerman very soon started to create awareness and understanding regarding her initial question. This led to an increased understanding for herself and the involved technical partners, but also for consumers by translating her insights into an interactive installation for the Embassy of Sustainable Design during Dutch Design Week in 2019: the ArtEZ Future Makers Labyrinth of Sustainability.¹² Moreover, it is in co-reflecting on her visualizations and the test results of her samples with other stakeholders (fellow designers, textile researchers and manufacturers), that a shared understanding is being created that becomes meaningful in different contexts. Interdisciplinary reflection and interaction within Baggerman's design research is a necessary condition to learn and create new knowledge, yet at the same time the visual (i.e. diagrams) and tangible (i.e. prototypes) knowledge that Baggerman creates through this interaction is what actually facilitates co-reflection and co-visioning. Baggerman's diagrams and prototypes serve as boundary objects to bridge (potential) knowledge gaps between designers, manufacturers and researchers. Ultimately, the result of this design research can be a (communication) tool for her as a designer (and possibly also other stakeholders) to create a shared language and shared understanding and thus facilitate future co-design projects.

Bugter's aim is very similar in the sense that in her design research project she is also creating a communication tool, but her starting point is different as she aims to understand and visualize the bigger picture in the form of an infographic. Instead of unravelling a product, she aims to unravel and map the complexity of the whole system. Also reflecting on her own position and role as a designer, Bugter starts with the (knowledge and (conflicting) interests of) different stakeholders and different types of value creation (profit/capital), which makes both the design process and the outcomes more abstract. Bugter's intention to research the bigger picture comes from her conviction that honesty and transparency are important values for change. Her research process is highly iterative, constantly moving back and forth between collecting data, making sense of the system and translating it into a frame, and reflecting on and revising the frame with different stakeholders inside and outside the project. Co-dreaming/ co-playing and co-visioning are overlapping within this process. The process is very much driven towards understanding, but also critically questioning the status quo and thus looking for alternatives and positioning different stakeholders within the bigger picture. Visualization is key here, to make sure that it serves as a communication tool. Bugter aims to develop a shared vision and shared aims on a systems level, which is more abstract than when co-creating a product. The direct value and therefore the mutual benefit for different stakeholders is less concrete or more open-ended. Without explicitly addressing it in this way, Bugter's design research appeals to the role and importance of empathy within multi-stakeholder collaborations, which cannot be overestimated.

¹² <http://www.labyrinth.artez.nl/>



Els Bugter

I felt the need to create a model that both visualizes the system and places changes in context. [...] It allows me personally to recognize sustainable initiatives and better understand the impact. Above all, it gives me more insight into the motivations of stakeholders and therefore a better understanding of the process behind the transition to a sustainable system.

Both Baggerman and Bugter address designers' abilities to change perspectives. They consider it part of a designer's toolkit to 'break through disciplinary boundaries' by adopting and developing a shared language (Baggerman), and to 'make connections' by visualizing ideas and visions that are not (yet) reality (Bugter). They critically assess and question their roles as designers and design researchers in relation to other stakeholders within the complex system of the fashion and textiles industries. Bugter does so by being a 'helicopter', while Baggerman takes a closer look at how numerous decisions that affect sustainability are often unconsciously made or based on assumptions.

These two case studies illustrate how translating circular design principles into actual design practices can be rather complicated due to the interdependencies between the many steps in the production process and the many stakeholders involved operating at different levels within the system. As Baggerman explains, "many decisions in a design process are made as isolated decisions", but in order to take a circular design approach you have to see and understand the relations between these decisions and, Bugter adds to this, the motivations and mindsets of different stakeholders. This "understanding" is what Baggerman and Bugter aim for, to actually empower and enable different stakeholders to act and communicate responsibly. Designers and design researchers who aim for a more reflective and process-oriented approach can thus take the lead in co-design for understanding as part of and in support of circular design principles like design for emotional durability and design for attachment and trust.

5.2. Co-design for use(r) value

Designer Hellen van Rees and design duo Brecht Duijf & Lenneke Langenhuijsen (Buro Belén) design with the user in mind. The creation of aesthetic, emotional and personal value is a crucial part of their circular design principles with the aim to create attachment, trust and emotional durability. They share the vision that aesthetic qualities contribute to emotional attachment and thus can extend the use phase of a product. Within their (GC)² design research projects, they are both dealing with technical limitations and challenges that affect not just the product's aesthetics but also its sustainability. Co-creating with technical stakeholders is an important part of this process, which Van Rees and Belén each approach in a different way.



Hellen van Rees

It's always responding to new knowledge and then improving the processes. The more I learn about it, the more I learn that to really be a sustainable fashion designer, you have to transition from having your design being informed by the aesthetics, to being able to combine that with all the technical limitations. The more sustainable something is, the more you have to be informed by the technical possibilities and limitations and adjust the design to that.

Van Rees started with a very open-ended process, approaching manufacturers from the very beginning to let her design be inspired by potential ‘flaws’ and production errors. ‘Flaws’ are only considered ‘flaws’ within a specific context, and designers’ ability to change perspectives (which we have already seen in the cases of Michelle Baggerman and Els Bugter) can thus help to reduce ‘waste’. However, we have to be careful to claim that these abilities or competencies can only be assigned to designers. It needs a certain openness to re-frame and see different opportunities, which is also key to the approach of Annemieke Koster (Enschede Textielstad). Koster and Van Rees thus share a similar vision and approach, but bring in different types of knowledge regarding technical possibilities (Koster) and design opportunities and consumer needs (Van Rees).

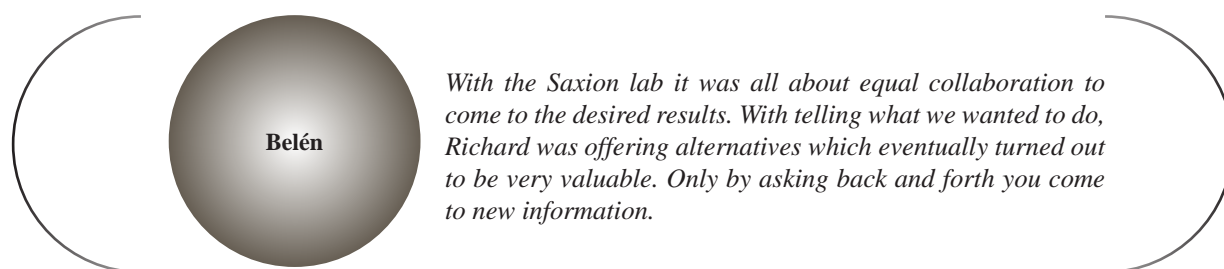
By transforming production flaws into design features, the designer creates new value. The manufacturer in this case is not creating value in the traditional sense, since the ‘products’ are partly based on coincidence and thus relatively unpredictable. However, the manufacturer needs to see and understand the potential value of the flaws/errors of production, in order to achieve a successful collaboration and value creation. In the case of Van Rees and Koster this process works very well, due to a shared (open) mindset and creative approach, but also facilitated by physical proximity and thus (frequent) direct contact. The equal, open and curious dialogues demonstrate how both designer and manufacturer are learning from each other and change their perspectives. Through close dialogue in different stages of the process, technical limitations thus become design opportunities. Van Rees’ aim to design for dis- and reassembly furthermore became part of the dialogue with technical partners, including Anton Luiken (Alcon Advies). Facilitated by her modular concept designs and prototypes that served as boundary objects, these dialogues resulted in learning for all partners.

The co-creation process for Belén was different in the sense that the designers’ questions that guide the collaboration with technical partners are more goal-oriented and aimed at more specific aesthetic and functional needs. Duijf & Langenhuijsen selected and approached technical partners (Saxion and Alcon Advies) for their material experiments on the basis of the specific technological knowledge and expertise that the designers needed to realize their design goals. Technical limitations and challenges then play a similar role in the dialogue between designers and manufactures (Enschede Textielstad) as in the case of Hellen van Rees. However, when the manufacturer comes into the process in a later stage as in the case of Belén, more time and effort might be necessary to find mutual interests and align goals and expectations.

Involving new stakeholders throughout the process always brings in new perspectives, which can drive innovation forward but can also bring unexpected limitations. Knowledge institutes like Saxion have other expectations and ways of working than manufacturers like Enschede Textielstad, while both have valuable expertise and resources for research and development. When moving from a phase of small-scale exploration and experimentation to a phase of (scaling-up) production, which is necessary for Belén when aiming to make an impact for the user, designers and manufacturers have to deal with questions of (shifting) control and ownership. The dialogue then aims towards finding mutual benefits; establishing a relationship based on transparency and trust becomes even more important now. This takes time and requires an open mindset of both designers and manufacturers. In a co-design process, the designer is no longer in charge, nor is the manufacturer. Van Rees in particular stresses the importance of curiosity and openness towards different perspectives, as well as being aware of knowledge gaps. Designers are traditionally trained and used to be in charge and work in an autonomous way, to collect all necessary information and define their own vision. Within this project, Van Rees deliberately works in a different way that is being informed and guided by the ‘flaws’ that production companies have to offer. To create a shared vision means designers (but also

manufacturers) have to learn to engage in and facilitate an open dialogue and embrace a more open-ended process. In collaboration with technical experts Van Rees' role is changing in the sense that her design decisions are much more informed by technical possibilities and limitations instead of working towards an aesthetic goal. This results in a change in attitude or perspective on how to approach technical partners AND clients/users.

While most of the design research cases within (GC)² primarily focused on the co-creative process of (material) development, the cases of Hellen van Rees and Belén also draw attention to the fact that circular design does not stop with the material or the product. Aesthetics play an important role for these designers to create (emotional) value for the user, in addition to transparency and trust. Van Rees also achieves this by strongly connecting to and engaging with her clients throughout the design process and creating unique, customized pieces. The question remains however, when and how should the user be involved in order to co-design circular value chains? Within (GC)² the focus was primarily on co-creation between designers and technical stakeholders. But both Hellen van Rees and Belén are rethinking and developing their business models in order to include the complete cycle which involves much more than co-creating materials and products.

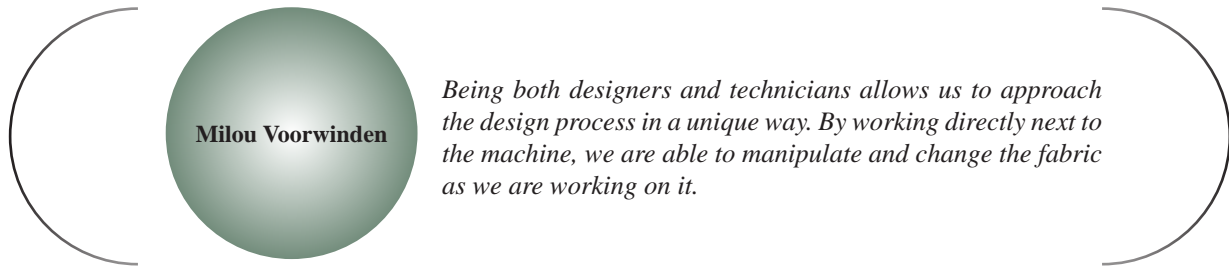


Finally, although not directly related to specific circular design principles, these two cases very much illustrate how physical proximity still plays a strong role in facilitating smooth collaboration and communication. The Netherlands is a small country, and the industry is used to operate globally, but being co-located in the same city as in the case of Hellen van Rees still enhances more frequent physical contact and exchange, and therefore seems to help in building shared understanding.

5.3. Co-design for material and process innovation

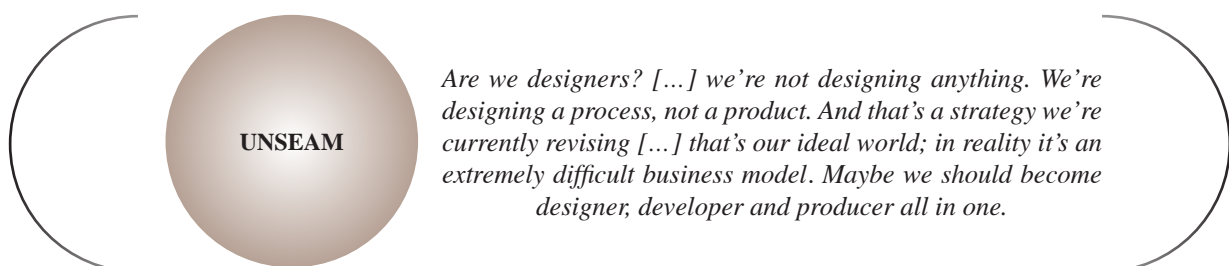
Ultimately, circular design is not (just) about designing new products – we already have too many of them – but about rethinking and re-designing the system. Design duos Bas Froom & Karin Vlug (UNSEAM) and Suzanne Oude Hengel & Milou Voorwinden aim for developing innovative techniques and processes that can contribute to this transition towards circular value chains and business models. Combining design and technical knowledge and skills, both duos do not start from a specific product or client, but focus on material and technological (process) innovation to open up new ways of thinking and producing in textiles, fashion and interior design. Within their (GC)² project Froom and Vlug do so by building on their UNSEAM 3D shaping process, exploring the possibilities of new materials (cellulose based textiles) and processes (sustainable laminating techniques). Oude Hengel and Voorwinden approach textiles as construction material and research and experiment with yarns' technical properties such as shrinkage, stiffness and elongation to create 3D woven textiles. More specifically within their (GC)² project Oude Hengel and Voorwinden experimented with woven binding structures to create 3D shapes through folding lines. In order to drive innovation both design duo's are pushing the boundaries of industry standards and practices by asking 'unusual' questions in the eyes of conventional manufacturers. Properties like shrinkage are usually seen as unwanted and need to be avoided. To aim for high shrinkage or to calculate and control shrinkage in specific

areas of the textile disrupts a manufacturer's usual practice and thus requires a certain openness and curiosity to experiment (which the technical partners in (GC)² clearly have).



While their 3D shaping ambitions show technical similarities, UNSEAM and Oude Hengel & Voorwinden have different ways of approaching and engaging other technical stakeholders in their process. One of the main partners for UNSEAM in this project was Permess, to explore the possibilities of their laminating process and a biodegradable glue. UNSEAM and Permess clearly share sustainable values and vision: they both value local production, focus on sustainable impact, and are open for experiment. Furthermore, Froon and Vlug do not want to disrupt existing processes. They start with what is out there and then explore whether they can align their own ambitions with Permess' vision, aims, and opportunities. Compared to Oude Hengel & Voorwinden, UNSEAM is much more business-oriented and more experienced and aware of the need to align interests and find a common goal in the field of collaboration/co-creation in order to make impact on a bigger scale. Froon and Vlug are aware of the necessity to take into account what the market/the client is willing to pay for. However within (GC)², UNSEAM's design research is highly explorative. In a funded research project like (GC)², there is more space to get to know different stakeholders without the immediate need to make a business. Collaboration with designers for Permess is mainly driven by curiosity, while Froon and Vlug gained more insights into large scale local production. Likewise, experimentation with Enschede Textielstad was enhanced by similar visions on sustainability and local production, as well as by the small scale of this business and mutual interests to explore new business opportunities (co-producing).

Suzanne Oude Hengel & Milou Voorwinden are more research-oriented and focused on the material from their own expertise. They have the technical knowledge as well as some equipment to conduct a considerable part of their experiments on their own, involving other technical stakeholders like Saxion and Enschede Textielstad whenever there is a need for additional expertise or production facilities. One may call this co-producing, but it is not based on collectively developed aims or vision. However, this project has helped Oude Hengel and Voorwinden to reflect on the value proposition of their design practice, which seems to shift from mere product designers to design researchers. Co-design and co-creation with stakeholders like Saxion, TU/e and Alcon Advies is thus more focused on knowledge creation than business opportunities, which might offer more space for real open-ended experimentation.



The ways in which both design duos approach and engage technical stakeholders in their material and process experimentations have implications for the changing role of designers in circular design and value chains. Due to their technical expertise and the partly business oriented approach of UNSEAM and the more research oriented approach of Oude Hengel and Voorwinden, there seems to be only a fine line between being a designer, technician, and researcher or entrepreneur. Co-design for material and process innovation clearly requires both design and technical knowledge and expertise. The question remains however whether experimentation and exploration of new techniques or applications always benefits from multiple stakeholders. If a designer has the knowledge, competencies and equipment, is co-creation with other stakeholders needed in the early stages? Sometimes innovation can benefit from a certain ‘distance’, as designers or design researchers collaborating only with the material have more freedom to design according to their own ways of thinking and working. However, whether new ideas evolve into impactful innovations depends on their actual implementation and therefore collaboration is needed (eventually). And then again it remains an open question whether this collaboration would be easier if there is a collectively developed aim or shared vision from the beginning? The case studies in this project do suggest so, but that doesn’t mean that collaboratively designed products, materials or processes are by definition better or more valuable than individually developed innovations – it seems a balancing act in which designers need to constantly reflect on their own position in relation to the impact they want to achieve.

5.4. Co-design for circularity: concluding remarks

The three co-design focus areas are more about the role/position of the designer than about actual design principles/strategies. All three areas are needed in a circular design approach – combining products and processes as well as bridging the gap between different disciplines and stakeholders. The positions of designers are not static, but can serve as a starting point in the dialogue with other stakeholders.

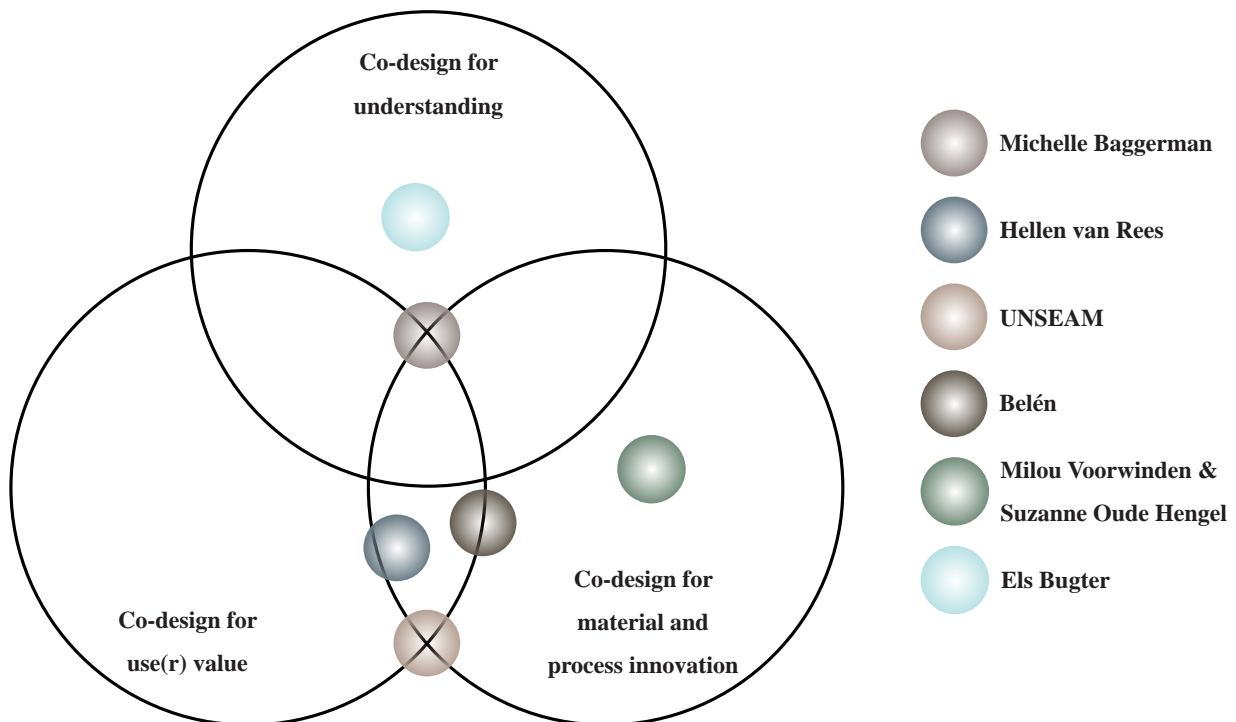


Fig. 16: Model from supply chain regarding product development to systemic change and value creation

6. Conclusions

Based on our analyses of the research-through-design within the work package ‘circular design’ we would like to highlight several recurring themes, key insights and main conclusions regarding the issue of multi-stakeholder co-creation, circular design principles and co-design for circularity. Our key conclusions are related to the context and interdependencies of the design principles, the practice and abilities of designers and their circular design process, the role of design objects in creating a mutual language and understanding, the underlying values required for co-creation and co-design, the role of aesthetics and the relationship with the user and/or wearer, and the ‘intimacy’ and relational proximity needed for local, circular processes of production.

6.1. Interdependencies of Contextual Design Principles

The case studies illustrated the complexity of the interwovenness of technical, design and business decisions related to practicing circular design principles. A pitfall of working with circular design principles is that only focusing on one principle does not ensure circularity. The design principles do not work in isolation and prioritizing only one of the principles is not – or only partially – beneficial. A risk is also to establish hierarchies between the principles as this overlooks their interdependencies. Understanding the interplay between specific circular design principles – and thus combining several design principles – is essential for a circular design practice. An important challenge is to put these design principles into practice within specific contexts. Our analyses highlighted that the value of co-design and co-creation processes is highly context-dependent. Therefore, it is important to develop a kind of agility, a design agility and a *circular agility* – as a circular design skill, mentality and/or competence to be able to practice circular design in a flexible way, adapting to changing circumstances and different contexts with and different partners, and working with different design principles.

6.2. Design Agility & Changing Perspectives

This agility is already inherent in the practice, skills and mindset of some circular designers. Within the (GC)² project, several designers clearly expressed a kind of agility by, for example, always responding to new knowledge, and having the ability to reframe (new) challenges, change perspectives and to see new opportunities. The analyses of the case studies illustrated how designers do not only struggle with the complexity of questions of circularity and co-creation within fashion and textiles, but they also see opportunities to address these complexities in novel ways. Through close dialogue in different stages of the process, technical limitations thus become design opportunities. This could also mean that new or other circular design principles become more important during the process. For example, in the case of Hellen van Rees, the importance of modular design (dis- and reassembly) gained in importance. Another example is Bas Froom, who said: ‘we are now trying not to work as a designer, but more as researchers and developers of technologies’. This demonstrates how some designers are already flexibly responding to what is required at a particular moment in the process of trying to reach their circular ambitions. Our research has also shown that a local proximity between partners as well as a physical proximity to the user helps to increase this agility. We recommend doing further research on how to develop agile design practices in relation to circular design principles.

6.3. From an Intuitive Design Ethos towards Informed Decision Making

Working with the circular design principles, within the context of the (GC)² project, has been especially helpful as learning tool to develop the rationale and logic behind a circular design practice and thus to guide the design, co-creation and decision-making processes. Circular design principles often subconsciously guided most participating designers' practice, and most designers were subconsciously aware of circular design principles as part of their design ethos. Also, certain underlying values such as honesty and transparency related to circular ambitions, were often already part of the designers' vision and intuitive way of working. Yet, circular design principles were often not consciously operationalized into concrete methodologies. It was especially the project context and the design exercises with the conscious reflection on the design principles that proved helpful for designers to critically reflect on their role, reevaluating their approach, to help positioning themselves within the textiles and/or fashion system and to make circularity part of their agenda. Thus, actively using the circular design principles as a way of constantly reflecting on new ideas, helped to frame circular design thinking, which allowed more informed decision making. For example in the cases of Els Bugter and Michelle Baggerman, these principles did not only serve as a framework to guiding their thinking, but also as a tool for communication and making that explicit through communication tools – allowing other stakeholders to make informed decisions. In addition, while the designers had difficulties defining the abstract notion of 'co-creation', some of them seem to co-create quite naturally in practice. Our research has shown how circular design principles can help designers to reflect on their role in designing for circularity, both by themselves and in interaction with other stakeholders.

6.4. Co-Designing Boundary Objects as Learning Experiences and Shared Languages

Within the (GC)² project, we aimed to create more mutual understanding by moving beyond all stakeholders speaking their own language. The designers' abilities to translate (abstract) knowledge with and for different stakeholders by making it tangible, visual, understandable and usable has been significant – to take on different approaches and to develop a shared language. Co-designing boundary objects is a way to do so. In this project, for example, Michelle Baggerman's tea towels served as boundary objects (cf. Stompff, 2020; Stompff & Smulders, 2013) to facilitate learning experiences with all actors in the value chain. In this case, samples were used as boundary objects to facilitate communication and shaping a shared vision between stakeholders. Here, co-designing boundary objects was essentially a learning process in which disciplinary boundaries were crossed and knowledge gaps between designers, manufacturers and researchers were bridged. The visual (i.e. diagrams) and tangible (i.e. prototypes) knowledge that Baggerman created through interdisciplinary reflection was simultaneously what facilitated co-reflection and co-visioning. The tangible forms that operate as a shared language allowed different stakeholders to better understand co-creation practices in relation to circular design principles, which led to Michelle Baggerman coining a new circular design principle: design for understanding. Co-reflecting with multiple stakeholders through circular design principles as well as boundary objects have been learning experiences that facilitated a mutual understanding. As Els Bugter highlighted, this has also helped to understand the underlying motivations and mindsets of different stakeholders, which is necessary for a collaborative mindset and a co-creative process. It takes time to learn how to engage in and how to facilitate an open dialogue while embracing an open-ended process, but this will result in establishing a relationship based on transparency and trust.

6.5. Beyond Designers as ‘Chain Directors’, towards Equal Relationships

In circular design processes, designers are often ascribed or expected to have several roles and responsibilities, from product designers to process designers and facilitators. While the designers have taken a leading role in the circular design processes in (GC)², we find it important to critically reflect on the idea of designers being the ‘chain director’ and/or creative directors of the whole process. As Hellen van Rees has indicated, for example, designers are traditionally trained to be in charge and to work in an autonomous way, to collect all necessary information and to define their own vision. While this is crucial because it enables designers to take on different roles, beyond concept and product development, this also creates a hierarchy that some designers feel uncomfortable with and that may be unproductive. In actual co-design processes, the designer is no longer in charge, nor is the manufacturer, or any other stakeholder for that matter. The mostly equal, open and curious dialogues within this research project demonstrated how both designer and manufacture can learn from each other and can change their perspectives in doing so. The main starting point in designing for circularity and co-creating knowledge and awareness, in our view, is based on transparency, trust and empathy as the core values of an equal relationship between different stakeholders – which will also lead to shared value creation for all stakeholders. For actual processes of co-design, these shared values form the foundation based on which open dialogues, personal connections and empathetic relationships can be built. A designer who would act as ‘chain director’, being in the lead on the process, means that, for instance, manufacturers operate in service of their design process. Our research has shown the importance of dissolving these hierarchical relationships, in order to find common ground, and work from shared values towards common goals. Co-creation has proven easier when the relationship between several partners is built in the early stages of the process and when it is more open-ended from the start. The partners then build and develop their aims and expectations together in a more equal way. If the collaboration is established later in the process, more time and effort is needed to negotiate interests and to find common ground. Thus, investing in connecting, finding common ground, exploring and establishing sharing values, and understanding each other’s motivations and background, open dialogues are key in order to develop equal relationships and to work from trust, empathy and transparency.

6.6. Beyond Aestheticizing the End Product, Towards Aesthetically Sustainable Value Creation

This project did not only critically reflect on the role of the designer as a ‘chain director’, but also on the role of the (circular) designer as simply creating a beautiful end product. While some technical stakeholders and manufacturers expected the designers to work from ready-made textiles to make aesthetically pleasing end products, it is important for circular designers to be involved in the early stages of material development. Aesthetic and technical qualities are deeply interconnected, as the cases of, for example, Belén and Hellen van Rees have clearly shown. Moreover, this research has shown that creating aesthetic, emotional, and socio-cultural value should necessarily be combined with creating technical, functional and commercial value, which means that circular design processes contribute to multi-layered value creation. Aesthetics also play an important role for designers who aim to create trust as well as (emotional) value for and with the user. Some designers explicitly aim to create trust through aesthetics. Hellen Van Rees achieves this by strongly connecting to and engaging with her clients throughout the design process and creating unique, customized pieces. Creating close relationships with users, also needs to be supported through a business model that centers around establishing meaningful social connections and relationships, which may strengthen the relationship to user behaviour (aesthetic usability effect) to encourage circular behaviour. As we have

seen, Brecht Duijf and Lenneke Langenhuijsen, for example, aim to ‘empower usability and increase the user’s willingness to learn and adapt’ by offering an ‘aesthetically pleasing experience’. Indeed, more and more designers aim to create and enhance a personal, emotional connection between user and product, putting into practice their approach to ‘aesthetic sustainability’ (Harper 2017). Yet, an unanswered question still is to what extent the user and/or wearer should actually be involved in co-designing circular value chains, which requires more research. In addition, as we have also seen, in relation to circular design principles, design decisions are much more than before informed by technical possibilities and limitations instead of privileging an aesthetic goal. Nevertheless, for the transition to a circular fashion and textile system, it is important to no longer perceive designers as being primarily engaged with creating a beautiful (end) product, but as active contributors to multi-layered value-creation that allows to build a stronger, meaningful relationship with the user and/or wearer.

6.7. Circular Intimacies and Relational Proximity

Focusing on local production of textiles based on sustainable cellulose fibres in the (GC)² project highlighted how a sense of proximity helped in facilitating circular design processes. In some cases actual physical proximity helped to develop a shared understanding, as frequent direct contact contributed to smooth communication and collaboration. For example in the cases of the collaboration between Annemieke Koster of Enschede Textielstad and Hellen van Rees, who are located in the same city of Enschede. Physical proximity – a physical ‘intimacy’ – has been relevant in several co-creation processes with different stakeholders for circular co-design. Yet, as Anja Köppchen pointed out in her PhD dissertation (2014): physical proximity helps, but relational proximity might be much more important. For example in the case of Hellen van Rees and Annemieke Koster, the process was easier because they are located in the same city, but if they would not understand each other and/or would not have had a sense of shared values and a sense of ‘being on the same page’, co-creation still would not work. Boundary objects could also enhance this relational proximity, because they bring stakeholders closer together (which has nothing to do with physical proximity per se). Relational proximity – as a form of ‘circular intimacy’ - is required for co-design processes for circularity.

Within this project we also reflected on ‘circular intimacies’ in terms of the ways in which circular designers work *from* the (possibilities) of the material more and more, which we called ‘material intimacy’, as discussed during the research groups’ round table discussion during the Dutch Design Week 2020.

6.8 Closing remarks

In the course of finalizing (GC)² and writing the end report, the textile and fashion industries face new, urgent challenges due to the covid-19 pandemic. The (GC)² design projects were conducted before the covid-19 outbreak. This new context leads to new challenges and questions regarding co-design and co-creative circular practices, and whether this may or may not accelerate the transition towards a circular textile and fashion system remains to be seen. However, we feel that our research confirms the importance and added value of multi-stakeholder co-creation, circular design principles and co-design for circularity in this transition.

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8. Colophon

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