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# Textile thinking in practice: Creative textile design methods as research in a circular economy

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**Abstract:** This paper presents a new analysis of practice research work exploring Textile Design for Disassembly as a design for recyclability strategy. It suggests a response to challenges relating to blends in the context of a circular textile economy. This paper highlights the potential for qualitative and creative textile design methods to produce research insights. Three textile design methods: the mood board, textile sampling, and garment prototyping, are reviewed in terms of their contribution to research. The methods are used to frame the problem space, develop a range of solutions, and test these in concepts that can materialise future fashion systems. The textile design methods are combined with information visualisation to produce insights. The approach thus makes visible some inherently tacit knowledge embedded in the textile design process. This supports a better understanding of the mechanisms for change towards sustainability at the core of design practices.

**Keywords**: textile thinking; circular economy; textile design for disassembly; visualisation

## 1. Introduction

In the context of a climate emergency, fashion systems are set on trajectories that ignore planetary boundaries; solutions that onboard all stakeholders in the industry are needed. The role of designers has long been put forward as both a direct contributor and a potential response to environmentally damaging products and behaviours (Papanek, 1985). This paper articulates the benefit of exploratory textile design methods to address the pressing issues of waste and recycling in the textile design sector.

### *1.1 Textile blends as a challenge to recycling*

Of the total input of fibres for fashion, less than 2% is currently recycled (Ellen MacArthur Foundation, 2017). While the flow of textiles bought and thrown away urgently needs to decrease, solutions to effectively recover the materials in these textiles need to be developed to increase the rates of recycling.

According to Cradle to Cradle (McDonough, 2005) and the Ellen McArthur Foundation (2017), an essential principle to ensure ease of recycling in a circular economy is to avoid combining resources from different cycles in the same material or product. They offer a distinction between the Biosphere and the Technosphere. The Biosphere includes materials which can be assimilated as nutrients in natural environments, such as through composting, at their end of life. On the other hand, the Technosphere includes synthetic and man-made materials which cannot be composted but that can be regenerated through a range of industrial processes such as mechanical or chemical recycling. All these regeneration processes, whether they occur in Nature or in a factory, are optimal when treating a single material type that isn't contaminated by a resource from the opposite cycle (Eco TLC, 2014). Thus, blends of natural and synthetic fibres are inherently difficult to recover and recycle (Östlund *et al.,* 2017). Designers combining different resources in one textile are essentially designing dead-end waste, materials which will have no further future after their first use. The research laid out here acknowledges the key role of textile designers in creating barriers to recycling through blends and offers a new perspective on blending that tackles this short-sightedness.

## *1.2 Textile design for disassembly as a solution to blending*

While mono-material design plays an important role in enabling circularity for the textiles industry, in some instances, it may fail to accurately fulfil the needs of designer and users alike. There are some instances where mono-materiality will struggle to fulfil function and cost requirements for textiles, but this study specifically considers the creativity and ingenuity that comes with the unexpected combination of resources. As put by Koestler "the creative act consists in combining previously unrelated structures so that you get more out of the emergent whole than you put in" (Koestler, 1989:392). The research presented here therefore explores ways in which the performance and creative benefits of material combinations can be achieved without hindering end of life recovery and recycling of the resources.

Design for Disassembly (DfD) is relatively commonly used in production and industrial design when dealing with items that contain precious or toxic elements that come with high incentives to manage adequately at end of life (Dowie, 1995; Crowther, 2005; Chiodo and Jones, 2012; Ziout, 2013). In this work, this circular design strategy has been adapted to the context of textile design.

Textile Design for Disassembly (TDfD) is proposed as a strategy for the combination of materials with detachable connections which enable the recovery and recycling of the components that enter this new type of blend (Forst, 2018). The production of a repertoire of techniques for assembly and disassembly of textile components which enable the ease of recovery and recycling is a key part of this research's contribution to knowledge. Through this experimentation to develop these practical alternatives to current blending, some transferable

insights concerning the role of creative textile practice as a research method were put forward. Thus, this paper focuses mainly on the value of textile design practice as a qualitative research method and its potential to deliver insights for a circular textile economy.

## *1.3 Wicked problems*

Rittel argues (1972, quoted in Buchanan, 1992:16) that the problems addressed by designers are most often what he describes as wicked problems. These are issues that encompass broad systemic frameworks and do not offer a clear pathway to a potential solution. The issues with blend recyclability are typical of a wicked problem in the way that the question itself can take on different forms and subsequently be addressed in a variety of ways.

As argued by the critical design theorist for textiles and materials Elaine Igoe (2013), textile designers are particularly comfortable with high levels of uncertainty which are an inherent part of the practice. This positions textile design as an interesting candidate to take on a wicked problem such as blend recycling. Using practice to solve such a complex problem steers the research through the embodied knowledge inherent to textile design. Rather than formulating the issue and the steps to a solution in a prescriptive way, following the flow of creative practice lets the concepts emerge in the safe environment of the studio. Where quantitative analysis approaches might encounter limitations in particular considering the scale and complexity of the issues in the textile supply chain, creative textile design practice thrives in the fuzzy front end of a wicked-problem-solving process.

Acknowledging that there is no right or wrong answers to a wicked problem, only a gradient along a scale of good or bad designs (Malpass, 2017), TDfD does not suggest a perfect solution to blend recycling. Rather, the practice shapes the understanding of the problem as is carves out new ways of solving it. This flexibility and the uncertainty inherent to wicked problems means that the brief may shift in response to the exploration of a new approach to the issue.

## *1.4 Qualitative methods*

Textile design is inherently qualitative in the sense that it pertains to material qualities, it is a discipline tightly connected to tacit knowledge (Igoe, 2010). This research suggests that the issues caused by textile design when creating barriers to recycling might best be addressed in the same frame of mind and with the tools that are specific to designers. Indeed, while much research is bent on solving the industry's over-production, over-consumption, and waste issues, a comprehensive and quantitatively accurate view of the situation is hard to achieve. The fashion system is uniquely complex with entangled networks of suppliers, brands, users, and very little transparency across the sector (Fashion Revolution, 2020). Attempts to measure and classify the types and quantities of waste can only grasp locally specific and non-representative sample sizes of the bulk of garments going to waste every second. These quantitative snapshots of the issue are necessary but have limited effect when it

comes to developing solutions with a wider range. Taking on the qualitative, material-led approach of textile design can thus help understand and address the challenges of blend recyclability in the practice of making textiles that elude quantitative measurements.

While it may fall short of providing a blanket solution to the current issues of waste, TDfD offers an alternative to designing blends that prevent recycling by tackling the source of the issue in the creative textile design process itself. TDfD can thus be called a pro-active measure, as opposed to a reactive one that would address waste already in circulation (Goldsworthy, 2012). It aims to replace current practices which tend to cause recyclability issues further down the line, with ones which make future recycling easier. While it can be coupled with practices which use recycled materials, the main aim isn't to address current waste but rather to eliminate it in the future by considering existing and emerging recycling criteria from the start of the design process. Therefore, TDfD speaks specifically to designers, and takes on their vocabulary and methods to infiltrate the creative process with circular design strategies.

## 2. Textile thinking as a qualitative research method

Textile design entails different ways of thinking, from the micro to the macro, considering whole systems as well as technical challenges, for example in the details of a woven structure. This places the textile design researcher in a unique position to address issues which require multiple perspectives. Adding the rigor of research supports the use of such qualitative methods to solve some of the pressing issues in the industry.

### *2.1 Textile thinking and research methods*

As a discipline that sits at the fringe of traditional design practices, and by extension, also holds a special position in design research, textile design suggests specific ways of thinking and of experiencing the practice of making which have been described in relation to the production of new knowledge in research (Igoe, 2013; Earley, 2018; Forst, 2020). This work endorses the description of Textile Thinking as described by Igoe (2021) and other designer-researchers in this area. In this sense, it is put forward as a cognitive mode which is manifested in the act of making textiles and drawing transferable insights from both process and outcome. As put by Igoe: "The indivisibility of thinking, making, knowing with, in and of itself, bound up with the agency of materials themselves, becomes the premise of textile thinking" (Igoe, 2021). The three textile design methods reviewed here each offer a uniquely 'textilic' mode of thought, which is essential to their potential to leverage circular design approaches within the practice of making new materials. Splicing Pajaczkowska's Psychoanalysis of Nine Types of Textile Thinking (Jefferies et al., 2015) with Studd's (2002) description of the textile design process, it is argued here that drawing inspiration material together in the form of a mood board, experimenting with textile techniques through sampling, and testing ideas in use scenarios through garment prototyping, each contribute to an enhanced understanding of the opportunities and challenges in making textiles for a circular economy.

Furthermore, both the act of making and the results are argued as valuable research methods. As put forward by human-centered design researcher Priti Rao (2012), designers tend to stray away from established rules and methods and rely on intuitive decision making throughout their creative process. Furthermore, communications design researchers Joyce Yee and Craig Bremner demonstrate how in doctoral research in design, "the usual academic norm of using an established method or methodology is often discarded in favour of a 'pick and mix' approach to select and apply the most appropriate method" (Yee and Bremner, 2011:1). In textiles, this mixed approach to methods has been named a bricolage approach. Sustainable fashion design researcher Clara Vuletich (2014) connects the French origin of the word "bricolage" to the idea of tinkering. As put forward by Parisi, Rognoli and Sonneveld (2017) tinkering is closely related to a tactile perception of materiality and intuitive responses through design practice. Vuletich goes on to frame this idea of bricolage specifically in terms of textile design for sustainability: the crafts-based angle of the discipline resonates with the exploration of solutions based on tacit understandings of materials and processes rooted in tinkering. The bricolage approach "folds multiple layers of knowledge and discourse together creating novel points of interaction between the researcher and the researched, producing enriched interpretations of the subject of study" (Philpott, 2013:39).

Drawing together the parts of the textile and fashion design process as the steps of a research journey is one of the key contributions of this work. The iterative exploration of TDfD concepts and practical applications is framed as a set of qualitative methods that can be employed in other fields to produce similar progress in applying circular and sustainable design strategies to a given issue.

## *2.2 Complex contexts and textile design*

As well as the distinctive 'zoomed in' cognitive mode that goes with the detailed making of cloth or embroidery, textile designers also benefit from a wide view. The fields of textile and fashion production, involve uniquely complicated supply chains and technical processes. The ability to navigate these spaces and the interdisciplinary relationships they incur is key to the success of a textile designer in the industry, and translates to addressing complexity in the context of design research for sustainability (Earley *et al.*, 2016). Designing for recyclability asks for the examination of multiple co-dependencies between the different stages of production, transformation, use and recovery of the textiles and products. This need to shift perspectives throughout the research process and examine details as well as systemic issues is aided by the qualitative textile design methods used in both examining and responding to the issue at hand.

The materials themselves offer opportunities to work in harmony within complex collaboration spaces. The multi-dimensional aspect of a textile sample or prototype can convey more meaning than verbal descriptions. Wilkes *et al.* (2016) propose that textiles act as boundary objects, and Hornbuckle (2010) adds that the material designer holds the role of a "material liaison coordinator" in facilitating the discussion around these objects to articulate the goals

and challenges of a given collaboration from multiple stakeholders' perspectives. In later work (Hornbuckle, 2020) relating specifically to science-design collaboration in EU funded project, the role of the material sample itself is emphasised as supporting multidisciplinary knowledge exchange and innovation. Practice-based textile design researcher Marion Lean (2020) also puts textiles and textile thinking forward as an ideal tool for expressing multi-dimensional problems and perceptions which would otherwise resist description.

In this work textile design methods are used to frame and make sense of the ambiguity surrounding the challenge of design for recycling. The process of gathering information from different perspectives is embedded in methods such as the mood board, or using samples as boundary objects in reflective analysis or in conversation.

### *2.3 Visualisation as practice*

In the context of this description of textile design as a qualitative research method, the results of the design process are used as data that can be reviewed to produce insights. In each of the three methods described here, the use of visualisation is key to highlighting transferable strategies to use such practice in other circular design challenges. As described by Manovich (2011), visualisation usually uses reductions of information such as graphical primitives to represent data, in conjunction with spatial variables, to draw meaning through patterns and relations. However, Manovich also describes the use of direct visualisation, or media visualisation, in which all or part of the objects are used in a spatialised representation as a way of demonstrating patterns. The approach described here is a form of direct visualisation in the sense that the images of case studies, samples or prototypes are used as a rich representation of a part of a system.

Visualisation is useful to extract insights in a reflective review of the making process and outcomes which might resist identification in the moment. Indeed, as described by Harrison (1978), as soon as the maker starts describing their activity, they are no longer making, but speaking instead. Across the field of design research different approaches have been used to overcome this, such as filming the hands of the maker as they operate (Atkinson, 2019) or by describing the process as it unfolds (Philpott, 2011).

This work proposes visualisation as a hybrid method that is both a practice of design, such as with the conventional use of mood boards, but also a way of drawing intermediate knowledge (LÖwgren, 2013) from creative outcomes. The three approaches described here are reviewed first in terms of their role as creative practices, and then through the lens of information visualisation in terms of their contribution to the research.

## 3. The Mood Board as problem framing

In the way that a literature review generally pre-empts a research project, design projects start with a review of existing practice that can be used as inspiration. The first phase of this work combines both approaches to identify gaps to address in subsequent work.

## *3.1 The Mood Board*

In the context of an ill-defined, or wicked problem, the designer's skills can be channelled to first analyse the context and create a "problem frame" (Cross, 2011:22) which sets the space to explore solutions and the boundaries and rules for the work. Moxey also defines this initial phase of gathering information to lay out what he calls the problem space in textile design practice (Moxey, 2000:53). Using this approach, the first stages of this work were aimed at understanding the issues concerning blends and recycling to define the problem frame or space. This was done using textile design practice, and in particular the gathering of inspiration references in the way of a mood board.

As stated by fashion design researcher Tracy Cassidy, mood boards are "a vital part of the design process that facilitate creative and innovative thinking and application" (Cassidy, 2011:1). They allow for the combination of ideas in the same visual space, essentially enabling a form of bisociation (Koestler, 1989). Building on Koestler's idea of bisociation, Biskjaer expands it to the creative process itself, arguing that using design "materials" (i.e., inspiration images) provides "a creative result by combining various, discrepant elements" (Biskjaer et al., 2018:1291). This is precisely the role the mood board plays in this work.

Selected cases of practice across disciplines were reviewed to understand the state of the art in DfD. These cases were drawn together to nurture the subsequent practice. Conventionally, mood boards "are tools used by designers to bring together apparently incongruent visual data to promote inspirations to develop suitable end products" (Cassidy, 2011:227). This work takes this approach further by classifying the different cases based on the scale and level of user involvement represented. As a bridge between the traditional academic field review and the mood board, this method shows the gaps to address.

In response to Igoe's framing of design problems for textile designers as being "entirely tacit" (Igoe, 2013:95), this phase of understanding the issue has enabled the development of a problem articulation which draws directly from the textile design and making experience. Framing of the issue in this way has highlighted the gap to address in subsequent practice to develop TDfD techniques.

## *3.2 Visualising the problem space*

When gathering case studies that represent design for disassembly, the untreated information from the practice equates to the results of a brainstorming activity, in which, as put by Jones: "the immediately valuable output is not the ideas themselves but the categories in which they are placed by classification" (Jones, 1970:275). Building on this, the transferable value of the practice does not come from individual case studies, but rather from the categories which give them a broader meaning. This shows a shift from an understanding of the state of the art to the definition of targets for this work.

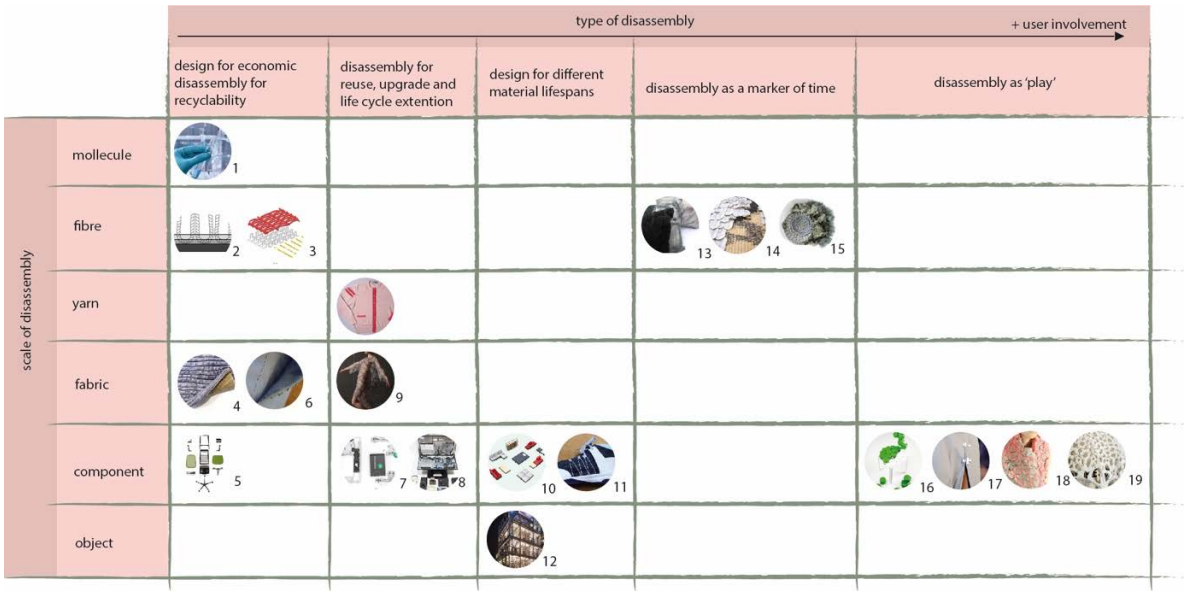


*Figure 1. Visual representation of the case study images against categories for DfD*

These categories shown in figure 1 set the framework for an expansive typology of DfD approaches. The cases, selected for the way in which they represented exciting opportunities for DfD, are mapped on a grid charting the scale of the elements that are disassembled (molecule to object) against the type of disassembly considering user involvement (from economic consideration to play). This table shows the areas for which few or no cases were found. This suggests exploring the ways in which yarn and fabric components could be assembled and disassembled while considering material lifespan, markers of time, or play as part of the subsequent sampling and prototyping.

## 4. Textile sampling and process mapping

With under-explored areas mapped by the classification of DfD case studies, the research set out to explore assembly techniques that were inspired by the mood board review. Textile samples show a translation of principles seen in architecture or product design to the scale of yarn and fabric component assemblies. These are then reviewed through the visualisation of the creative process expressed in the samples themselves.

## *4.1 Creative textile design production*

The series of samples (see figure 4) explores techniques such as laser cutting and hand assembly, weaving, and felting to demonstrate ways in which different components can be brought together for novel technical and aesthetic effects while allowing for the mono-material parts to be disassembled for effective recovery and recycling at end of life. The sampling uses the prompts from the inspiration phase, but the hand is guided by the materials in iterative making.

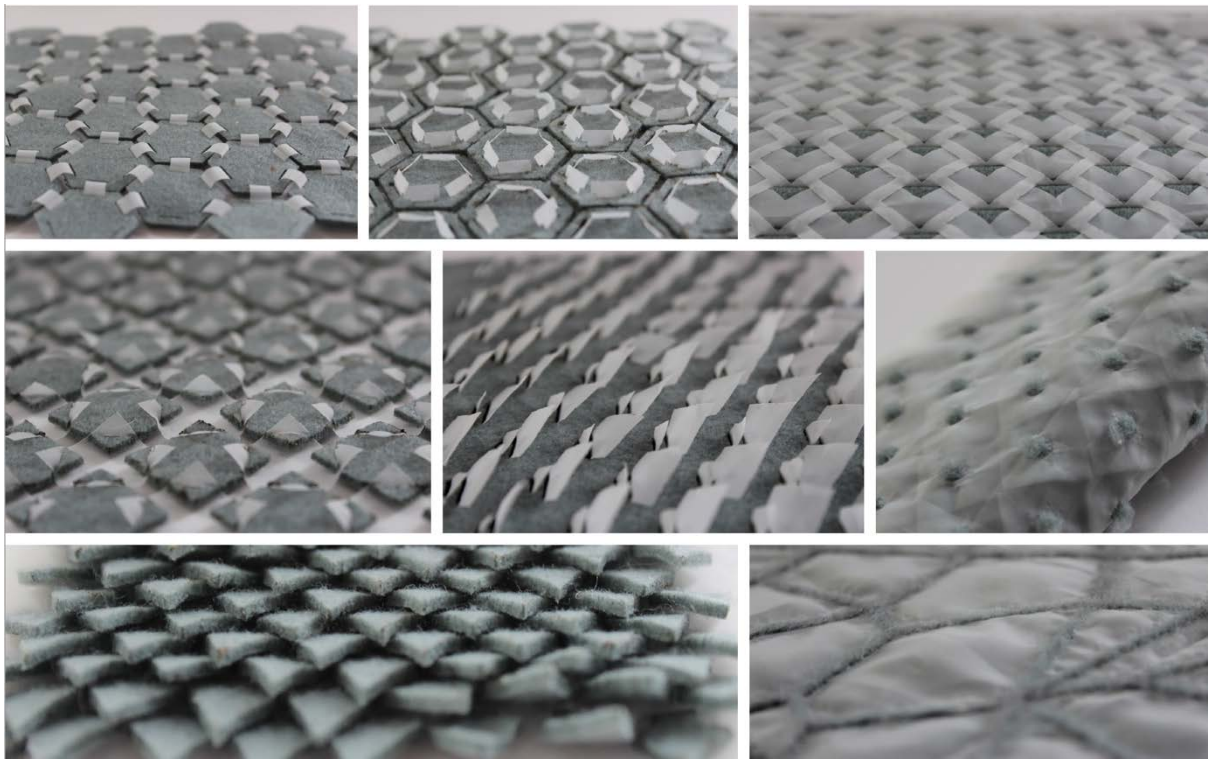

*Figure 2. Examples of samples from the collection showing different TDfD techniques*

Materials innovation and design researcher Elvin Karana suggests that "material engagement in craft is a means to logically think, learn and understand through sensing and immediate experience of materials" (Karana et al., 2015:38). The combination of a tacit understanding of materiality with logic is very typical of the textile making process and has been articulated as a key agent in the value of creative research (Niedderer and Townsend, 2014). Thus, the sampling helps materialise the imagined possibility of TDfD, manifesting new techniques that can lead to innovative approaches to textile construction responding to recycling challenges.

The position of textiles in the world of design is ambiguous as it is in part a discipline in itself, but the results are generally integrated to other disciplines, rubbing out the role of the textile designer in the final outcome which is available to the user (Igoe, 2010; Studd, 2002). Textile designers often produce samples that are adapted to a specific product only in retrospect, thus leaving most of the qualities of the fabrics to be defined by the designer's intuition alone in this ill-defined problem space. The samples thus often have a hybrid role in

which they are both the result of a design process and representations of ideas, proposals and possibilities (Morrow, 2014:457). In the same way, the samples developed here offer propositions for the potential application of TDfD to a given product context. As a collection, they offer a repertoire of techniques that can be adapted to specific materials or use challenges.

## *4.2 Mapping the textile design process*

The exploratory samples testing the potential of TDfD techniques made in a free-flowing process were then reviewed through mapping. This retrospective analysis of the creative process embodied in the series of samples aims to draw insights for the transferability of this approach. Textile designers are accustomed to letting themselves be guided by the materials (Igoe, 2013; Marr and Hoyes, 2016; Philpott, 2011), thus the retrospective reflection on action (Schön, 1983) highlights transferable insights without stifling the creativity of the process. This can provide a framework for the replication of this type of approach to new circularity problems.

As shown in figure 3, the review of this iterative process identified four assembly techniques that adapt DfD to the practice of textile design. These took the form of temporary assembly methods which can be produced using textiles techniques such as weaving, felting or laser cutting and hand assembly of materials. By mapping the sampling process in this way, not only does the research produce a repertoire of techniques for TDfD, but it also shows the creative meandering which leads to the evolution of techniques, suggesting pathways for further development in other practice.

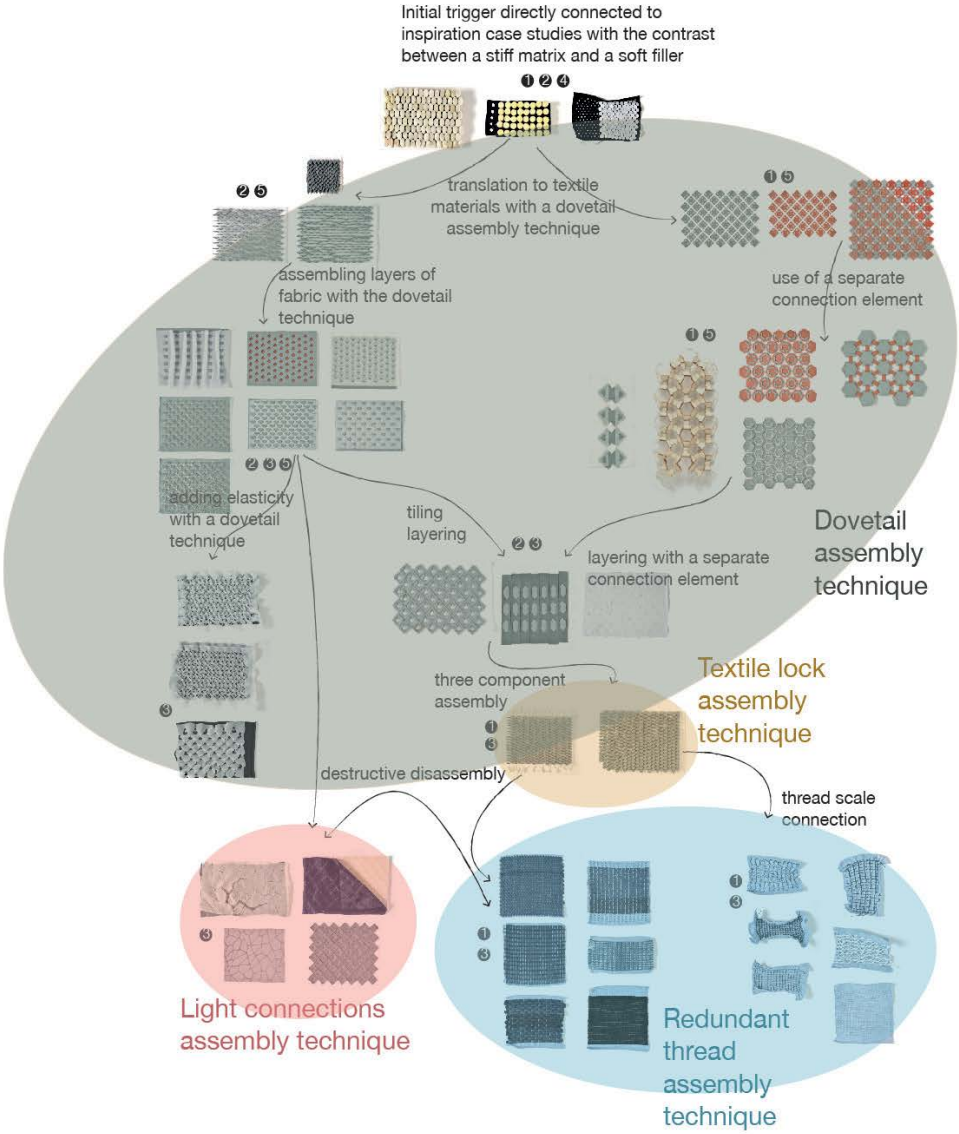


*Figure 3. Visual representation of the iterative sampling process showing evolutions in the techniques and the four categories that emerged*

## 5. The garment prototype as object of analysis

The techniques for TDfD can be applied in a product context where the disassembly potential will enable recyclability and other corollary effects such as lifecycle extension. Prototyping garments therefore contributes to further testing TDfD, but also to considering the systems in which it might be effective.

### *5.1 Garment prototypes*

The experimentation with TDfD was transferred to the development of product prototypes. As defined by design thinking approaches, prototyping is an essential tool in the formation of innovative concepts as it materialises ideas that did not previously exist (Brown and Katz, 2009; Rowe, 1987). This gives a more solid structure on which to build future experiments,

making opportunities and limitations apparent. Brown argues for the use of prototyping in the earliest stages of product development, and for the need to use the lightest, fastest, and cheapest methods to do so (Brown and Katz, 2009:90). This is in order to trial the effectiveness of any type of concept before the designer becomes too invested in it and reluctant to do away with elements of the design. The prototyping phase refines the object by discarding the superfluous aspects of a design to focus only on the most effective way of achieving the set goal. Rowe describes the process as a generate-and-test approach to highlight how each prototype validates or disproves versions of the solution and adapts the brief for the next iteration in ways more conducive to success (Rowe, 1987:59).

Two jacket prototypes were made to demonstrate the use of TDfD. The first one was produced as part of the author's supervisor's work, the Service Shirt concept, as a step in a long lifecycle involving multiple phases of remanufacturing, including the shirt becoming the lining for a jacket as shown in figure 4. The TDfD techniques proved that a garment could be assembled and then deconstructed to be transformed into a new product, in this case a series of necklaces, made by a partner artisan, shown in figure 5, to extend the use of the materials to a maximum while not impeding recyclability at end of life.

*Figure 4. The Service Jacket made from a used polyester shirt for the lining, and a virgin polyester for the shell*

*Figure 5. Series of necklaces by Katherine Wardropper made from the jacket*

A second iteration on the jacket concept was the opportunity to test the TDfD techniques with a combination of two resources: a bio-degradable leather for the shell and a recycled and recyclable polyester for the lining. This brought the concept back to the original goal of bringing materials from different cycles together.

*Figure 6. The Split Jacket, made with a biodegradable leather outer layer, and a recycled lining*

## *5.2 Analysis and contextualisation*

In a similar way to that described for textile samples, as well as testing technical feasibility, prototypes have the potential to surface tacit or intermediate knowledge and can be effectively used as tools in research. Brown and Katz (2009), highlight the importance of prototyping as an ongoing process throughout a project, helping to form, as well as present, ideas. This also aligns with Horvath's approach to research by design in which "prototypes have the potential to form the basis of an understanding of the perspectives and practices" relevant

to the field (Horváth, 2007:10). Here, the two prototypes were reviewed to better understand the challenges in designing for recycling.

Visual evidence of the work was used to retrospectively clarify the different stages of the design and prototyping process. To understand the design journey that took place in the first iteration on the jacket motif, a combination of after-action review (Morrison and Meliza, 1999) and annotated portfolio (Gaver and Bowers, 2012; Sauerwein et al., 2018) methods were used. Both prototypes provided their own range of technical challenges and insights for the potential of TDfD, but the comparison between the different settings also highlighted some of the variables of designing for disassembly. These insights were mainly produced by a reflective review that considered the differences in terms of materials, design process, production, use, and end of life. Here again, the outcome of the making phase was used as data to be analysed to draw transferable insights for circular design.

Moreover, this research proposes that prototypes have value in materialising visions for future fashion systems. Both prototypes not only demonstrate the technical feasibility of TDfD, but also give a material, qualitative sense of what such a future might look and feel like. As argued by Walker: “The essential core of creative design is not concerned with investigating what already exists but with envisioning what could be. It calls not on the power of methodical examination but on the power of human imagination and open minded exploration”(Walker et al., 2017:447).

## 6. Conclusion: Textile thinking in practice, surfacing tacit knowledge

Using the qualitative methods specific to the practice of creative textile design in research, this work has shown the potential for the use of creative practice to deliver concrete outcomes that suggest solutions to enable the recycling of complex materials combinations in a circular textile economy. The three methods shown here each use elements of textile design to frame, explore and contextualise problems and solutions in this area.

The benefits of this bricolage approach to research methods comes in the form of boundary-spanning insights that can embed sustainable design strategies within the creative processes responsible for making materials and products that currently hinder a smooth transition to a circular economy. As put by sustainable fashion design researcher Kirsi Niinimäki: “A design-driven approach and design research methods can combine tangible prototyping with abstract knowledge-building, haptic and creative experiences with cognitive knowledge-building, emotional experiences with technical knowledge, and further bringing in commercial reality to strive for future innovations” (Niinimäki, 2018:311). Thus, using the textile designer’s intrinsic abilities to move between different levels of understanding, from the micro, to the macro, to the holistic, can support transformational practices for the industry.

A limitation to this approach could be found in the intrinsically personal character of the textile design practice described in this paper. While the methods here are effective in surfacing

tacit knowledge for the designer, further steps may be required to apply the insights in collaborative work. The visualisation and articulation of the value of the different processes involved in textile design practice form a first step ahead of collaboration methods that facilitate the type of cross-disciplinary collaboration that is essential to addressing complex issues in a circular economy context (Hornbuckle, 2020). In other words, the methods described here offer a path for designers to better understand their own work and its value ahead of bringing this expertise to multi-disciplinary work.

This analysis has demonstrated the value of qualitative research and of textile-design-driven approaches to bridge the spaces between wicked problem framing, tacit knowledge involved in making and the application of solutions to future circular economy contexts. It proposes that using the tools of creative design such as inspiration gathering, sampling and prototyping, can foster innovation in the implementation of circular design strategies. Moreover, the reflective practice of research in particular in the form of information visualisation, itself a bridge practice, collects traces of the otherwise tacit processes and know-hows, so that these can be applied in other areas of design where making practices might produce solutions for circularity. While these methods were demonstrated in the context of textile design, they also hold value for other fields of design which follow similar patterns of inspiration, experimentation, and prototyping.

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