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The BIO TEN Design Guidelines: Inspiring biobased, local, durable and circular innovation in fashion textiles

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Abstract: Using design to change the way we make, use and reuse resources, materials, products, and services, has been widely recognised as an important element in creating a lower-impact clothing industry. A broad range of designers and sectors are involved in the various processes of decision-making that producing textiles and clothing entails. The research presented in this paper is concerned with how we might train professional designers working in SME's – small to medium scale enterprises - across Europe to make durable, long-life clothing that will be appropriate and fit for use within the emerging circular bioeconomy. This paper presents work developed as part of the design work package of the HEREWEAR project. The project is an EU H2020 FNR-2020 funded initiative (Food and Natural Resources), bringing together 15 different partners from 13 countries to explore systemic innovation for circular, biobased, local textiles and fashion. The HEREWEAR consortium is developing new fibres from agricultural waste -agriwaste - and pioneering (digitised) production, use and business models for local contexts. The design researchers in the project are tasked with the development of guidelines for biobased, circular, and local fashion textile design. This paper introduces the guidelines and discusses their value as a tool for professional training of design stakeholders, in the transition to a sustainable and circular fashion industry.

Introduction

This paper presents research concerned with a training framework for designers in small to medium sized clothing companies in Europe, with a focus on regional contexts and values, as well as using bio-based materials, made from agriwaste streams, in ways that make the new clothing durable and long-lasting, as well as recyclable at end of life. The training framework builds on previous training offers, which have been widely tested in industry and academia, but in this project more specific conditions have been applied – local, circular, and bio-based.

Context

In the context of a climate emergency, design work must be aimed at shifting the current situation towards a decarbonised, sustainable, and circular state. The IPCC warns that the timeframe for change is short, and that drastic action must take place across sectors (Intergovernmental Panel on Climate Change, 2022). The fashion industry, notorious for its heavy impact on the environment and its ill-treatment of workers across the globe is coming to terms with the scale and ambition of the changes needed (Amed *et al.*, 2022). Many initiatives are currently under way to address the various angles of the crisis, from slowing consumption (Coscieme *et al.*, 2022), to driving a shift to circularity (Duhoux *et al.*, 2022; McKinsey, 2022), to creating roadmaps for net zero (Earley 2021). This research positions itself within this context and offers a complementary perspective by aligning topics such as circularity and decarbonisation in a way that can be relevant to design stakeholders in professional learning contexts.

The HEREWEAR project (HW)

The HEREWEAR project aims to contribute insights and practical recommendations for the use of novel biobased fibres in local and circular contexts. The project partners are developing new fibres from agricultural waste and experimenting with PLA from sugar cane as alternatives to the ubiquitous use of cotton and polyester. This offers opportunities to move away from the fragile global supply chains meshed with these resources. To support this shift, attention is brought to the potential of local networks for manufacturing and use and reuse of garments, exploring new business models and the potential of the micro-factory concept.

Circularity is a pathway to improved sustainability, and whilst garments are designed for long lives and multiple repair and reuse cycles, they are also considered as resources for future products and designed as such. To support designers with navigating these aspects of a transition to a sustainable fashion industry, a set of guidelines have been created and are presented in this paper. The work presented here stems from this recognised need to continue educating professionals for a transition to a decarbonised and sustainable fashion industry and explores the challenges of providing adequate information and formats for this audience. Lifelong learning is argued as a key part of professional life, in particular in an ever complexifying world (Laal and Salamati, 2012).

The boundaries between where knowledge is acquired (education) and where it is applied (work) are blurred (Fischer, 2000). The tools for lifelong learning are many, breaking beyond adult education to include self-directed learning and collaborative practices. Knowledge exchange (KE) has been articulated as the bridge from fundamental research to applied contexts in industry and professional practices (Yusuf, 2008).

The many approaches to knowledge exchange which contribute to the application of emerging research to applied contexts and to gain new insights from these contexts are drawn from to produce a resource that is useful to design stakeholders in facing the challenges of a transition to biobased, circular, and local fashion systems. It is acknowledged that knowledge is not a fixed thing (Fazey *et al.*, 2013), and that in the process of exchanging with design stakeholders to produce the outcomes presented here, iterative versions of the guidelines were shaped in conversation between the research team and design stakeholders.

Methods

The aim of the work described here is to inspire fashion brands to explore biobased, local, durable, and circular innovation. The team developed a framework and a set of guidelines to achieve this aim. The method used was to adapt a set of existing guidelines (The TEN[1]) developed and tested in previous projects to the specific context of the HEREWEAR project. The new guidelines (The BIO TEN) were developed via a literature review of existing industry design and production recommendations and supported with a review of key case studies from contemporary design practice. The draft set of guidelines were then used in a series of four workshops with project partners and with small fashion brands and industry representatives in Romania and in Belgium.

The design decisions that related to the developing guidelines were reviewed and mapped against the material lifecycle of a biobased fashion textile[2] in online workshops hosted in Miro in the first workshop with project partners. Then the guidelines were taken to design students at the University of the Arts London and to groups of fashion SMEs and industry stakeholders in Iasi and Antwerp, to test the use of the guidelines in the design process and review the garment concepts that were collaboratively created using the BIO TEN as inspiration. All workshops were designed and facilitated by the authors and colleagues (based at Centre for Circular Design, UAL).

Dates & Locations	Participants
June 2021, Dec. 2021, online, in Miro	SME project partners: Vretena, Mitwill; Technical expert HW project partners: DITF, Rise, Circular.Fashion
Jan. 2022, London, UK	Graduate diploma students in textile and graphic design courses
May 2022, Iasi, Romania	Local fashion SMEs, community design HW project partner: Maibine
June 2022, Antwerp, Belgium	Local fashion industry stakeholders (policy makers, brands); Technical expert HW project partners: DITF, Centexbel

Table 1. List of workshops and participants

[1] *The TEN were co-developed between 1996-2009, at Chelsea College of Arts, London – first published as a card deck in 2010; then used with multiple fashion and textile and other companies, resulting in different versions being released over the years, along with animations and how-to films and workshop tools, www.circulardesign.org.uk/research/ten/*

[2] *The material lifecycle map is a tool to describe the different stages of the production and use of a biobased material https://herewear.eu/category/material-portrait/*

Using the input from the workshops, the wording and formats to communicate the guidelines were adapted to produce the guideline tools presented here.

The BIO TEN Guidelines

The TEN design for sustainability tool - a widely tested resource identified as one of the most effective for use by fashion designers (Kozlowski, Bardecki and Searcy, 2019) - has been used as the basis for these guidelines. We have taken our insights and findings from developing and working with The TEN over the last 12+ years, revised and updated them, drawing from our circular design work from recent research and industry projects, along with circular economy and circular design guidelines from other organisations. The result is a reframing of designing for bio-based textiles, keeping the broader, systemic transformative potential of The TEN, whilst also locating the specific questions that will enable appropriate decision-making with the HEREWEAR materials, products, partners, and broader communities.

The first set of strategies encompass selecting bio-based materials according to end of-life trajectories; production and waste reduction decisions, and textile selection – these are the elements that are essential to the guidelines as they are enacted by design stakeholders working at all scales. The second set of strategies ask the design stakeholders to ensure that the bio-based materials and products they are designing are as durable and long-lasting as possible. The third set of strategies are about the role design stakeholders must play in communicating the key messages around bio-based materials and products, so that users and others are involved in appropriate and effective ways in the bio-based circular models.

The flow represents a journey through the design decision making in order, starting with what you need to start with in circular design – the end of-life trajectory. The guidelines thus follow a full lifecycle approach, essential to circular design, but also offer a holistic perspective on the actions necessary for circularity by including communications and marketing for behaviour change.

Design for Circular, Local, and Less

The initial design process anticipates the potential for eventual recycling and re-purposing of the bio-based textile product. Designing with the end in mind steers our biobased material, product or service down a particular reprocessing or regeneration route. It encompasses selecting bio-based materials according to end-of-life trajectories and lowest possible impacts; production and waste reduction decisions – these are the elements that are most key to the guidelines as they are enacted by design stakeholders working at all scales, and it is here that the biggest impacts occur.

1. **Design for Recycling:** End-of-Life Trajectories & Cyclability; Donating, Collecting, Sorting
2. **Design for Production:** Local, Ethical & Sustainable Manufacturing
3. **Design to Minimise Impact:** Selecting, Finishing & Embellishing
4. **Design to Minimise Waste:** Zero Waste Patterns, Factory Waste & Fallout

Design for Circular Lifecycle Extension

Understanding more about the things we make, why and how people use them, stop using them, and how they get rid of them, is key to creating circular bioeconomies. It's important that we make bio-based products last for as long as possible. These strategies are about designing a bio-based material or product in such a way that the user can get maximum use and value from it during the period of their ownership, extending its life and therefore eliminating the associated impacts that comes with buying something new. It considers repair and upcycling which can keep the material in circulation for longer without having to break it down into a new feedstock.

5. **Design for Durability:** Physical, Aesthetic & Emotional Durability; Washability & Wearability; Repairability
6. **Design for Change:** Customisation, Multifunction, Adaptability & Modularity
7. **Design for Sharing:** Rentability, 'Swappability' & Returnability
8. **Design for Upcycling:** Remaking & Remanufacturing

Earley & Forst (2023)
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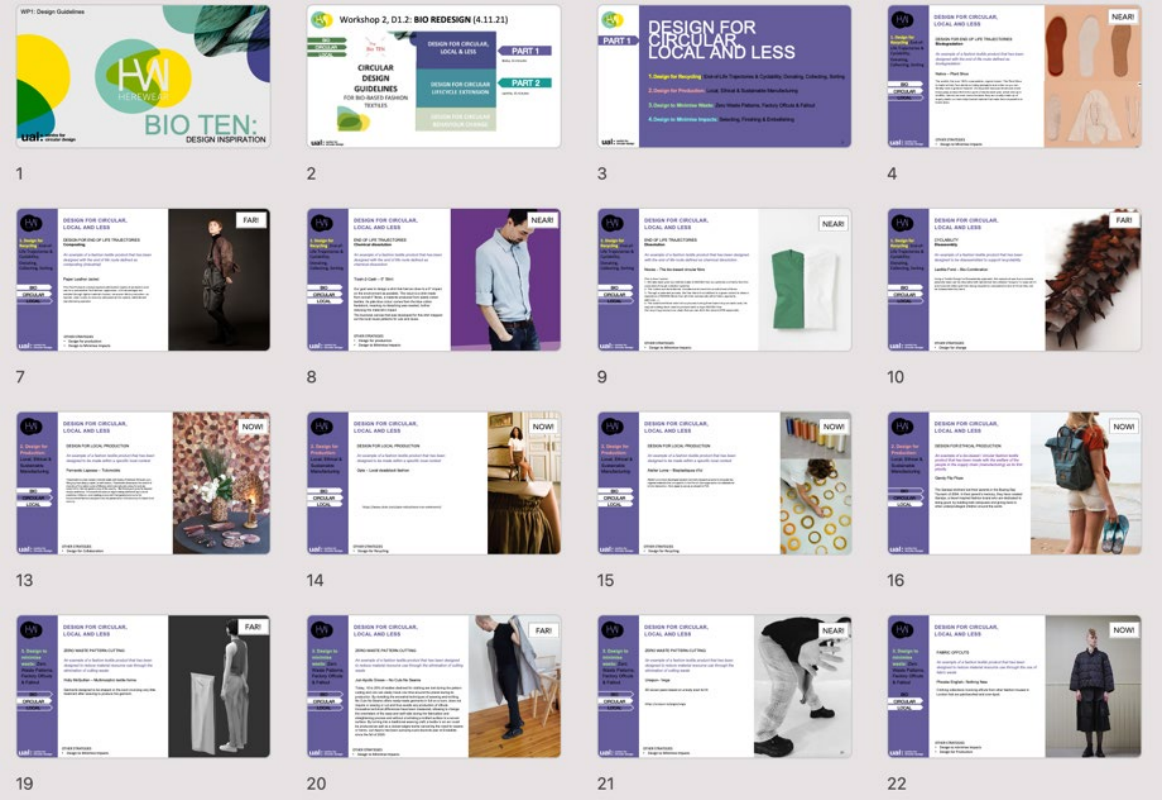

Figure 1. The BIO TEN design guidelines exemplars as a slide deck for presentation by an expert.

Figure 2. A BIO TEN exemplar slide with information relating to the innovation and coded against the biobased, circular, local approaches and the now, near, far placement.

Figure 3. An example of a design challenge card (left, the front, and right, the back of the printed card used in workshops).

Design for Circular Behaviour Change

Design can be used to create messages to drive behaviour change. These strategies are about the role design stakeholders must play in communicating the key messages around the bio-based materials and products, so that users and others are involved in appropriate and effective ways in the bio-based circular models.

9. **Design for Communication:** Reducing, Respecting, Labelling, Marketing & Activism
10. **Design for Collaboration:** Materials, Models, Mindsets & Methods

The BIO TEN in action

The guidelines' success is measured in relation to their ability to support the design process and lead to the creation of products and services which replace environmentally damaging practices with more benign ones. The BIO TEN were developed into communicable formats for knowledge exchange with designers and to support ongoing learning on the topic of sustainable and circular design as part of their professional practice. To illustrate each guideline in design applications, a series of exemplars were gathered (Figure 1). The guideline is put forward as a recommendation to design stakeholders alongside an example of how this might be affected. They offer a provocation to the learners and an example of how they might take such an angle on in their own work. The exemplars have been used both as a slide presentation delivered by a researcher 'expert' to a team of design stakeholders, or as cards for professionals to explore independently. (Figure 2)

A layer of analysis is included in the exemplar representations: It is acknowledged that very few businesses currently encompass all three of the HEREWEAR pillars, thus, each case study is marked to account for which of the pillars were addressed and which were left out. Similarly, the cases were marked as 'now, near, or far' to account for the fact that not all products and projects are at the same level of development, or occupy the same place in the market, in particular in the field of biobased materials (Lee *et al.*, 2020).

To build on the knowledge and inspiration acquired through the discovery of the guidelines through the exemplars, a complementary workshop tool for the adoption of the BIO TEN was developed – The Design Challenge Cards. (Figure 3) These cards convert the exemplars into questions for how designers might produce their own response to the guideline which uses all three of the HEREWEAR pillars. The questions are left open to prompt designers to imagine new products or services, while drawing inspiration from the case study provided. The design cards and the exemplars can be used together, starting with a presentation of all guidelines, and then moving to a design activity with the challenge cards, or separately. The aim is to support the exchange of knowledge from the research into the fashion industry, and gain insights from applied contexts.

The guidelines were used in workshops carried out with postgraduate design students and small brands. These events aimed to gather the community in specific local areas to discuss the challenges they encountered in relation to the HEREWEAR agenda in their work. To structure the discussion, the participants were asked to use the guidelines in a rapid redesign exercise, where they would reimagine an existing product, either from their own range or a classic piece, and weave in the recommendations to make it biobased, circular, and local. It was found that designers could easily integrate some of the lessons from the guidelines using the exemplars and that the lessons learned from the new garment concepts were useful to iterate and refine the tools. The variety of cases provided an open approach to the guidelines, rather than restricting the process they act as an inspiration.

The opportunity for design professionals in fashion brands to encounter the result of recent research can lead to the integration of circular and sustainable strategies. To make the recommendations from research inspiring, the tools to communicate them must be in line with their existing processes and speak their language. This project shows how in an iterative process with small brands, the research team developed variations to translate the new BIO TEN design guidelines.

Insights for biobased, local, circular fashion

Developing and applying the BIO TEN guidelines in garment concept development workshops with brands highlighted some of the challenges and opportunities for circular design with biobased materials, in local systems. It is widely accepted that these are three pillars of design for sustainability that can contribute to a needed change (Ellen MacArthur Foundation, 2017; Changing Markets Foundation, 2020; Textile Exchange, 2022). However, confusion and lack of accessible information remains an issue in professional contexts. It was found that widely used circularity guidelines needed to be amended to account for the challenge of working with novel biobased materials. It also became apparent that more detail could be added to the current recommendations on durability and repair to account for local contexts for manufacture, use and reuse. Bringing all three pillars together in a garment concept also pushes designers to think more holistically about resources, manufacturing, use and end of life, thus leaning into design for behaviour change for industry stakeholders and users. The BIO TEN guidelines offer the opportunity for designers to combine all key aspects of a sustainable fashion system in their decision making, supporting ongoing learning with tools for inspiration in the early phases of the design process.

Conclusion

To support ongoing learning in professional environments which will be increasingly shaped by the climate emergency, a range of tools must be available to designers, including resources to act as inspiration at the start of a project. As demonstrated here, open recommendations which offer an overview of the holistic approach to circularity which is necessary to operate a full industry shift can be used with design teams. There is also a need for technical tools that can give concrete and product related instructions, these are explored in the next phases of the HEREWEAR project. The project partners are continuing draw insights from knowledge exchange with fashion professionals and to explore how best to support designers including using qualitative insights from life cycle assessments (LCA) and developing a digital tool for product design development integrating biobased, circular, and local innovation approaches.

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