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The Wicked Problems of Durability: Rebound Effects and Textile Illiteracy in Circular Policy

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Abstract:
This paper takes its starting point from the EU Strategy for Sustainable and Circular Textiles which proposes that:

"Increased durability will enable consumers to use clothing for longer and at the same time support circular business models such as reuse, renting and repair, take-back services and second-hand retail, in a way that creates cost-saving opportunities to citizens" (European Commission, 2022).

While this statement positions durability as a cornerstone of circularity, and assumes that increasing product lifespan will naturally align with economic, environmental, and social benefits. This paper challenges that assumption by investigating the rebound effects and 'wicked problems' associated with durability as a driver for circular business models. By applying Rittel and Webber's (Rittel & Webber, 1973) framework, the analysis addresses multiple levels of root problems that complicate this narrative. Empirical data from two ongoing studies will be presented to illustrate how gaps in textile literacy—both in industry and among consumers—undermine the technocratic assessments underpinning EU strategies. These studies highlight how the erosion of textile knowledge over recent decades has left terms like "durability" and "circularity" poorly understood and misapplied. The concluding argument of this paper is that this lack of historical and practical textile knowledge within EU policy-making constitutes a rebound effect in itself. Without a deeper, more nuanced understanding of what durability and circularity entail and how they can be practiced, the strategy risks failing to achieve its intended positive impacts.

Introduction

Circular Economy Rebound Effects (CERs), as first articulated by Zink and Geyer (2017) critique the over-optimistic assumptions underpinning many circular economy strategies. They argue that "proponents of the circular economy have tended to look at the world purely as an engineering system and have overlooked the economic part of the circular economy" (Zink & Geyer, 2017).

Building on this argument, Siderius and Poldner (2021) contend that technological innovations aimed at fostering circularity cannot succeed without addressing broader behavioral and economic mechanisms. Similarly, Braun et al.(2021), show how product-level assessments can unintentionally exacerbate rebound effects by failing to incorporate system-wide analyses. In a Danish context, Dalgaard Nielsen & Skjold(2023) reveal how resale, if situated within a linear growth paradigm and fashion narrative, it will only drive additional production and consumption of both primary and secondary textile products. Finally, literature on design for longevity suggests that durability – or technical longevity of materials – will not alone support long-lasting use phases, as functional and emotional parameters must be taken into consideration as well (Hasling & Ræbild, 2017) Furthermore, focusing only on the materials and product design level will not leverage deep circularity, as these are nested in larger cultural, social, and economic systems (Engholm, 2023).

These critiques collectively challenge the EU's strategy for Sustainable and Circular Textiles (European Commission, 2022), which fundamentally bases its conception of circular economy on the concept of durability. Not

including a more holistic approach that incorporates cultural and economic dimensions, issues of durability become wicked and unresolving of root problems.

The wicked problem of policy

The concept of 'wicked problems,' introduced by Rittel and Webber (1973) offers a powerful lens for understanding the complexities of policy planning. Originally developed in a period of social and political upheaval, their framework critiques the tendency of policymakers to treat societal challenges as if they were scientific problems with clear definitions and singular solutions that too often generate new problems. A key feature of wicked problems is that every wicked problem can be viewed as a symptom of another, deeper issue why policy solutions often fail, because they address surface-level symptoms rather than the underlying root cause.

This perspective sheds light on the challenges in EU efforts of developing policies for sustainable and circular textiles. Central hereto is the concept of durability, here treated as an isolated metric rather than being interdependent with larger systemic issues. (Solis et al., 2025). For instance, overproduction and overconsumption are rarely addressed (Laurentiis et al., 2024). By failing to account for the interconnected nature of concepts like durability, EU policies risk perpetuating rebound effects.

Thus, this paper aligns with Rittel and Webber's critique: that wicked problems require nuanced, multi-dimensional approaches rather than linear, one-size-fits-all solutions. With this, we wish to showcase how a technocratic focus on measuring and assessing technical durability of textiles cannot stand alone, insofar as textile knowledge about what durability is and how it is practiced is currently not taken into account. The paper will argue how this to a large extent is a result of the efforts of cutting costs and making textile products more affordable through outsourcing of production throughout the last decades, which has made the fast fashion business model possible (Perry & Wood, 2019).

The problem of textile illiteracy

Understanding what textiles are made of, their properties, and the time, effort and cost it requires to develop them – is not compatible with the downward spiral of prices on textile goods that has escalated with the rise of fast fashion. This implies that the EU efforts of stimulating long-lasting, high-quality textiles that are affordable are paradoxical and unrealistic (Richardy & Skjold, 2023).

Still, the focus on assessing durability as a key part of the EU Strategy for Sustainable and Circular Textiles, lies in providing a standardized method for assessing environmental impacts, nested in the framework of the Product Environmental Footprint scheme (PEF). Increasingly, critics argue that it relies on oversimplified, technocratic approaches that fail to incorporate behavioral and cultural dimensions. Wiedemann et al.(2020) note that the PEF's heavy focus on lifecycle metrics neglects crucial aspects such as the functional and emotional durability of textiles—attributes that require a nuanced understanding of fiber properties and garment use patterns. This reflects a broader issue: the absence of textile literacy in policymaking limits the ability of tools like the PEF to drive meaningful sustainability outcomes.

One major factor contributing to the erosion of textile literacy is the massive outsourcing of textile production to low-income countries, catalyzed by the removal of the Multi-Fiber Arrangement (MFA) in the 2000s. The MFA had, in the period of 1974-2004, imposed strict quotas on textile imports to protect European manufacturing (Alam et al., 2018). Its removal allowed for an influx of inexpensive imports, leading to the near disappearance of domestic garment production in many European countries. This outsourcing not only weakened local industries but also severed the transmission of essential textile knowledge within the workforce. As Busch (2008) notes, the resulting "cheapification" of clothing further eroded consumers' ability to evaluate textiles critically.

This decline in knowledge extends beyond the industry to citizens at large, who often lack the skills to identify or care for textiles. For example, many consumers are unaware of the natural or synthetic origins of their garments or how to

assess their quality (Richardy, 2025 (forthcoming)). Concepts such as durability are thus poorly understood or misapplied in practice.

The erosion of textile literacy is also evident in education systems. As the fast fashion industry emerged in the 1990s, design schools shifted focus. Practical textile skills and techniques were deprioritized in favor of fostering artistic expression and cultivating fashion celebrity narratives (Zink & Geyer, 2017)(McRobbie 1998; Skjold 2008; Zink & Geyer, 2017). Consequently, today's design graduates often lack the material knowledge necessary to identify what durability means. This educational gap mirrors the broader societal trend, where the historical understanding of textiles has been supplanted by a consumption-driven mindset.

These intertwined root problems—outsourcing, cheapening, and educational shifts—have left EU policy efforts vulnerable to rebound effects. Without incorporating historical and practical textile knowledge, the EU's focus on durability, and tools like the PEF risks becoming superficial exercises, detached from the material realities of textiles. As Zink & Geyer (2017) point out, the deeper issue is not durability itself but overproduction and overconsumption—a challenge that cannot be solved without addressing the broader loss of textile literacy.

Rebuilding textile literacy is therefore essential. This paper will explore two initiatives aimed at addressing this gap: the development of fiber identification skills among Danish schoolchildren and a workshop series on historical repair techniques. Both initiatives illustrate how reconnecting with material and historical knowledge can empower individuals and inform more effective policy approaches.

Learning by Hand

The next two sections highlight ongoing studies affiliated with the Klothing research Centre at the Royal Danish Academy, Copenhagen, which address issues of textile literacy. First, the development of teaching materials for 30,000 pupils in public and high schools will be explored, emphasizing their goal of fostering fundamental fiber identification skills. Second, the creation of teaching materials designed to communicate textile knowledge—specifically related to repair—to museum visitors and a broader audience will be discussed.

The mass experiment

The empirical data of this case is anchored in the 2024 "mass experiment" on plastics in nature, in the home, and in textiles. The annually returning initiative is hosted by ASTRA, a Danish citizen-science organization for promoting teaching in the natural sciences for school children.

The study involved approximately 30,000 Danish schoolchildren aged 6-18. In the textile part of the initiative conducted by Richardy, the pupils engaged over two weeks in 1) conducting wardrobe audits, 2) sorting textile waste to be discarded from the home, and 3) identifying textile fibers. Here, we focus on the third element—fiber identification and introduce preliminary insights from the study.

Each class received an educational box containing materials such as a cotton ball, textile samples, fiber identification posters, and sensory blind test bags directly informed by Bang's comprehensive research on tactile and sensory learning (Bang, 2013). Furthermore, they were provided with supplementing identification tools like the textile identification key (Figure 1) and instructions for fiber identification through fire testing.

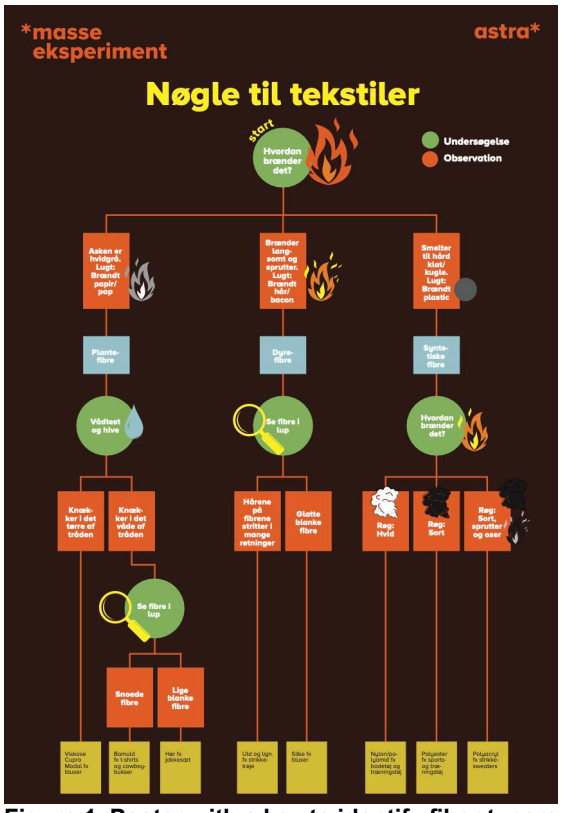


Figure 1. Poster with a key to identify fiber typers developed for the additional teaching material for the mass experiment 2024 © ASTRA.

This way, they performed burn, wet, and microscopic tests to analyze materials and participated in sensory exercises to explore textile properties by touch. These hands-on activities bridged theoretical knowledge and practical application, enhancing textile literacy and fostering environmental awareness.

This teaching kit was developed together with the experienced team of ASTRA and tested in week 17 2024 in a 7th grade class in a public school on Zealand. In situ observations were conducted for making the final improvements of the kit, and for exploring how the pupils interacted with the various elements (figure 2).

Figure 2. Test of educational material and survey in a 7th grade class on Zealand. © Richardy.

The insights from this pilot confirmed the need for a fundamental approach to textile education. For example, none of the pupils were aware of the origins of their garments—whether derived from plants, animals, or oil. Additionally, the blind test bags revealed that the pupils were unable to identify fibers based solely on touch.

In November 2024, a similar pilot test was conducted with students in the fashion and textile MA program at the Royal Danish Academy. During this test, students engaged in a panel training focused on the tactile properties of textiles made from different materials and weaves. The training aimed to develop a shared vocabulary for describing textiles and assigning functional properties to them. Through a series of sensory exercises, the students explored how factors like fiber type, weave density, and surface texture influence perceptions of quality, comfort, and durability. This collaborative process not only enhanced the students' ability to evaluate textiles systematically but also underscored the importance of tactile literacy as a foundational skill for addressing sustainability challenges.

These preliminary insights underscore the state of textile education in design schools in Denmark. Over the past two decades, the teaching of textile skills and techniques has been significantly reduced, with an increasing focus on artistic expression rather than material expertise. This shift, driven by the academization of design schools since the early 2000s, has rendered practical textile education increasingly inadequate (Skjold, 2008).

Hands in History

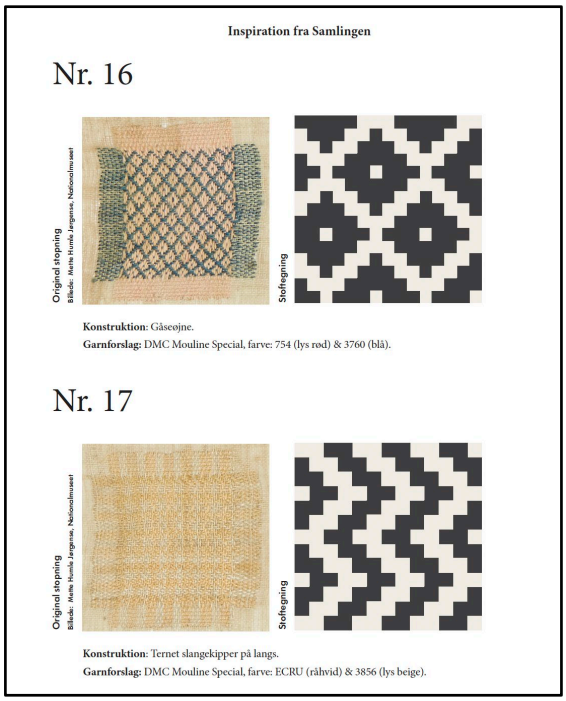
The outreach workshop series *Hands in History*, developed by the National Museum of Denmark (NMD), pay tribute to historic craftsmanship and are offered to museum visitors, In collaboration with Skødt, a workshop on repair techniques and darning was conducted twice—once in the Spring and once in the Autumn of 2024—and attracted 31 and 18 participants respectively.

These two-day workshops focused on historical darning techniques and the history of handicraft education in the Danish primary and secondary schools. One of the workshop's primary objectives was to highlight how techniques from the cultural history of textiles could contribute to

rebuilding citizens' competencies and knowledge in the maintenance and repair of clothing and textiles, thus promoting longevity and extended use of textile materials today.

The two-day workshops included lectures, a guided tour in one of the NMD's exhibitions, hands-on darning activities, and a presentation by a museum curator of darning samplers not currently on display. Participants were introduced to the historic technique of pattern darning, commonly seen in darning samples from the 18th and 19th centuries. Darning samplers are pieces of cloth on which young girls practiced advanced darning techniques for the invisible repair of clothing and textiles. These samplers are thus representative of the historically significant role that textile repair skills have played.

Participants of the workshops were provided with a material and tool kit containing various embroidery needles, two pieces of linen to accommodate different levels of complexity, and a booklet including a step-by-step guide to pattern darning and 25 patterns traced from a 1794 darning sampler, offering inspiration for the participants' own darning endeavors (figure 3). Yarn was also made available for the participants' use.


Inspiration fra Samlingen

Nr. 16

Original stopning

Stoffegning

Konstruktion: Gåseøjne.
Garnforslag: DMC Mouline Special, farve: 754 (lys rød) & 3760 (blå).

Nr. 17

Original stopning

Stoffegning

Konstruktion: Ternet slangekipper på langs.
Garnforslag: DMC Mouline Special, farve: ECRU (råhvid) & 3856 (lys beige).

Figure 3. Excerpt from booklet on pattern darning. © Skødt.

On the first day of the workshop, participants were introduced to the technique of pattern darning and began developing their skills using the provided materials (figure 4). The second day focused on the participants' own garments or other textile items requiring repair. Pattern darning was tested on modern pieces of clothing, and participants also experimented with other historical darning techniques, e.g., for knitted materials.

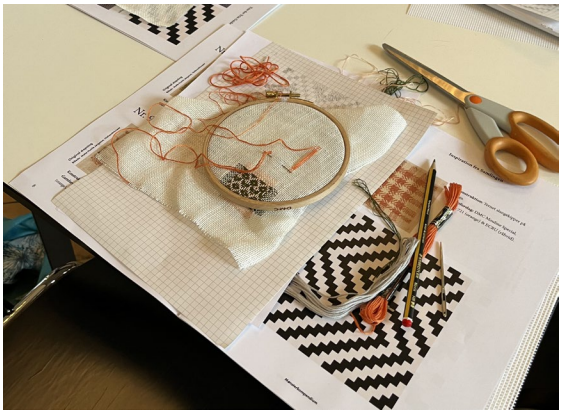


Figure 4. Ongoing pattern darning by workshop participant. © Skødt.

During the workshops, in situ observations were conducted for capturing reactions and responses regarding differences between historical repairs in the context of the teaching material, and the repairs of participants' own objects. Compared to the historical darning samplers, the darning of the participants' work showed less complexity, for example, due to using linens with a lower thread count. The complexity of darning which relate to the linen's thread count was tested prior to the workshop by Skødt and adapted to suit the timeframe of the workshop. Nevertheless, the participants expressed that they found the darning exercise difficult, but doable under guidance.

Consequently, the workshop showed, that the competencies level of the experienced textile craftspeople partaking the workshops was considerably lower than that of the past generations of women who sewed the darning samplers.

Discussion

Critically, the educational interventions of this paper are not merely stopgap measures, but foundational steps toward rebuilding a knowledge base that enables systemic change.

While handcraft education alone will not reverse the effects of outsourcing, it serves as a crucial strategy for reintroducing an understanding of fiber properties, durability, and repairability—skills necessary for evaluating and supporting sustainable textile systems. In contrast, onshoring production without addressing this knowledge gap would risk reproducing the same cycle of uninformed consumption and production under new economic conditions.

While onshoring may seem like a solution to the decline in textile literacy, lost knowledge does not automatically return with production. This decline stems not only from outsourcing but also from cultural and educational shifts that deprioritized material expertise—often termed the "industrial commons"—which does not regenerate on its own (Berger, 2013; Pisano & Shih, 2009). Instead, rebuilding textile literacy requires targeted education, historical knowledge recovery, onshoring of a textile infrastructure, and hands-on engagement (Alam et al., 2018).

Thus, investigating textile practices before fast fashion reveals a stark contrast to the limited and technocratic perception of durability as fiber strength alone: historically, skills in identifying fiber durability, functional and emotional properties, and market value were deeply integrated into societal norms, fostering what could be seen as a genuinely circular economy for textiles. One vivid example is the study of Ûlvang (2013), displaying how garments held significant economic and emotional value in estate valuations. To uphold this economic system of circularity, citizens were expected to understand, maintain, and extend the life of their textiles.

In contrast, modern CER literature critiques "circular" products for their limited appeal and value. Zink & Geyer (2017) emphasize how recycled or repurposed textiles often fail to substitute what they term ‘linear’ products due to lower economic, functional, and emotional worth. The Braun et al. study exemplifies this issue, comparing ‘circular’ and ‘linear’ work jackets without acknowledging detailed evaluations of how textile properties—such as weave density, fiber length, fiber quality, or sensory and aesthetic experience—affect durability. By overlooking these factors, lifecycle assessments risk reinforcing rebound effects rather than addressing systemic issues. Similarly, Larsen (2025) highlights how recycled fibers have historically been considered inferior and of lower quality, whilst they are currently being celebrated. This lack of textile knowledge amongst consumers, policymakers, and industry professionals allows superficial solutions to gain acceptance, without interrogating what truly constitutes concepts of durability.

Altogether, policies such as the EU Strategy for Sustainable and Circular Textiles, often align with what Bauwens et al.(Bauwens et al., 2020) describe as "weak circular economy", where linear economic drivers are patched with technocratic solutions rather than systemic change, which is evident when looking at the proxy of durability as ‘wicked’. In contrast, "bottom-up efficiency" approaches emphasize small-scale, community-driven production, leveraging local knowledge and skills for supporting local needs. The 2024 Circular Gap Report echoes these ideas, advocating for the development of “skills, capacities, and expertise” to support circularity that would require onshoring of a circular infrastructure (Matthew Fraser et al., 2024) – an ambition equally adopted by the Danish partnership for circular economy of plastics and textiles, TRACE (TRACE, 2025).

Aligning with the educational and historical initiatives discussed in this paper, these insights highlight the critical need for re-establishing textile literacy across society.

Conclusions

This paper is not a call to abandon scientific methods or metrics like lifecycle assessments. Instead, it emphasizes that natural science-based measurements must work in tandem with textile literacy to form a holistic understanding of concepts such as durability. Only by integrating these perspectives can we avoid rebound effects and prevent the worsening of current issues.

Examining the wicked problems of durability reveals a complex set of interconnected root issues that are symptomatic of one another and together constitute a ‘higher-level problem.’ The current siloed focus on validating and underpinning assessments of ‘durability’ through natural sciences and engineer-led thinking within EU policy makes circular economy rebound effects almost inevitable.

Instead, this paper proposes a deeper investigation into the parameters that define durability, grounded in a textile knowledge perspective, arguing that achieving deeper circularity will require a population re-educated in textile literacy and a strategy for onshoring a textile infrastructure within the EU. Without this effort, implemented alongside the development of science-based textile assessments, the current trajectory of EU policy will likely exacerbate rebound effects and worsen existing problems. Hence, the studies referenced in this paper collectively explore implications of the proxy of durability by integrating both material and cultural dimensions of textile literacy, thus contributing to a wider, deepened understanding of the concept of durability – one currently lacking in policy today.

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