2 - 4 JULY 2025
AALBORG UNIVERSITY

PLATE
Product Lifetimes
And The Environment

BOOK OF ABSTRACTS

6th Product Lifetimes and
the Environment Conference

DESIGN FOR LONGER LASTING PRODUCTS AND BUILDINGS · ENDURING CONSUMPTION · BUSINESS MODELS FOR LONGEVITY · REPAIR, CARE AND MAINTENANCE · PRODUCT LIFETIME MODELING · POLICIES FOR LONGER LIFETIMES · SUFFICIENCY AND DESIGN FOR LESS · REBOUND EFFECTS AND CRITICAL VIEWS ON PRODUCT DURABILITY · EDUCATION, TOOLS, AND GAMES FOR PRODUCT LIFETIMES · MATERIALS AND LONGEVITY · CLOTHING, FOOTWEAR, AND ACCESSORIES LONGEVITY · DIGITAL LONGEVITY

BOOK OF ABSTRACTS

for the 6th Product Lifetimes
and the Environment Conference

2 - 4 JULY 2025
AALBORG UNIVERSITY

Conference Venue

The conference will take place at Aalborg University's CREATE building.
Address: Rendsburggade 14, 9000 Aalborg

Registration desk working hours

Location: Common Area, Ground Floor

- Tuesday, 1st July: 11:30 – 16:00
- Wednesday, 2nd July: 07:30 – 16:00
- Thursday, 3rd July: 08:30 – 16:00
- Friday, 4th July: 08:30 – 12:00

Opening Session

Location: Room 3.107, Ground Floor

Wednesday, 2nd July, 09:00 – 09:20
Welcome by Head of Department, Lone Malmborg, and Linda Nhu Laursen, Head of Research at AAU Design Lab.

Keynotes

Location: Room 3.107, Ground Floor

Wednesday, 2nd July, 09:20 - 10:00
Henrik Mathiassen, CEO and Founder of DesignPeople

Wednesday, 2nd July, 10:00 - 10:40
Laëtitia Vasseur, HOP Executive Officer and expert on Circular Economy

Thursday, 3rd July, 9:00 - 9:40
Matjaž Malgaj, Head Of Unit - Coordinator of the Sustainable Products Initiative at the European Commission

Thursday, 3rd July, 12:50 - 13:30
Jeroen van Laer, Policy Officer at the European Commission

Closing Plenary and Award

Location: Room 3.107, Ground Floor

Friday, 4th July, 12:15 – 12:45
Closing Plenary and Best Student Paper Award

Refreshments and Lunches

Refreshments and lunches will be served in the common area at the Conference Venue (the CREATE building, Rendsburggade 14, 9000 Aalborg). There will be coffee in each break and water stations to refill water bottles in the common area.

Special Events

Wednesday, 2nd July 17:05 – 17:50
Thursday, 3rd July, 17:15 – 18:00
PLATE Workshops (signup required at the conference venue)

Tuesday, 1st July between 11:00 – 12:00
Friday, 4th July between 13:45 – 17:00

Waste Wonderland Exhibition at the Utzon Center.
Address: Slotspladsen 4, 9000 Aalborg.
Each will be provided with a ticket for one free admittance to the exhibition showcasing design experiments with industrial scraps and waste.

Social Events

Tuesday, 1st July 18:00 – 21:00
Voluntary PhD networking in informal settings.

Thursday, 3rd July 19:00 – 22:00
Gala Dinner at the House of Music.
Address: Musikkens Pl. 1, 9000 Aalborg.
No physical signup possible at the conference.

Friday, 4th July 13:45 – 15:45
Guided Tours of Aalborg – all free but need signup at the conference:

- Guided History Tour of Aalborg
- Guided Street Art Tour of Aalborg
- Guided Harbor Front Tour – Aalborg as an industrial city
- Guided workshop tour of the department's workshop facilities

Accompanying guests are welcome to attend.

TUESDAY

10.00 - 12.00: **Registration**

12.00 - 18.00: **PhD Colloquium**

18.00 - 20.00:
Voluntary PhD Networking

WEDNESDAY

8.00 - 9.00: **Registration**

9.00 - 9.20: **Welcome** 3.107

9.20 - 10.40: **Keynotes** 3.107

Keynote 1 - HENRIK MATHIASSEN
Keynote 2 - LAËTITIA VASSEUR

10.40 - 11.00: **Break**

11.00 - 12.15: **Paper sessions**

1	2	3	4	5
3.107	4.105	5.125	5.127	4.231

12.15 - 13.15: **Lunch**

13.15 - 14.45: **Paper sessions**

6	7	8	9	10
3.107	4.105	5.125	5.127	4.231

15.00 - 15.30: **Break**

15.30 - 16.45: **Paper sessions**

11	12	13	14
3.107	4.105	5.125	5.127

16.45 - 17.05: **Break**

17.05 - 17.50: **Workshops**

1	2	3	4	5	6	7
3.107	4.105	5.125	5.127	4.231	1.226	1.229

PROGRAMME

THURSDAY

9.00 - 9.40: **Keynote** 3.107
Keynote 3 - MATJAŽ MALGAJ

9.40 - 10.00: **Break**

10.00 - 11.50: **Paper sessions**

15	16	17	18
3.107	4.105	5.125	5.127

11.50 - 12.50: **Lunch**

12.50 - 13.30: **Keynote** 3.107
Keynote 4 - JEROEN VAN LAER

13.30 - 13.50: **Break**

13.50 - 15.20: **Paper sessions**

19	20	21	22	23
3.107	4.105	5.125	5.127	4.231

15.20 - 15.40: **Break**

15.40 - 16.55: **Paper sessions**

24	25	26	27	28
3.107	4.105	5.125	5.127	4.231

16.55 - 17.15: **Break**

17.15 - 18.00: **Workshops**

8	9	10	11	12	13
3.107	4.105	5.125	5.127	4.231	1.229

19.00 - 22.00: **Gala Dinner**

House of Music
Musikkens Pl. 1, 9000 Aalborg

FRIDAY

9.00 - 10.15: **Paper sessions**

29	30	31	32
3.107	4.105	5.125	5.127

10.15 - 10.30: **Break**

9.00 - 10.15: **Paper sessions**

33	34	35	36
3.107	4.105	5.125	5.127

12.00 - 12.15: **Break**

12.15 - 12.45: 3.107 **Closing Plenary Session**

12.45 - 13.45: **Lunch / Farewell**

13.45 - 15.45+: **Workshop tour**
Utzon Exhibition
Aalborg Cultural tours

TRACKS

- **1:** Design for longer lasting products...
- **2:** Enduring consumption
- **3:** Business models for longevity
- **4:** Repair, care and maintenance
- **5:** Product lifetime modelling
- **6:** Policies for longer lifetimes
- **7:** Sufficiency and design for less
- **8:** Rebound effects and critical views...
- **9:** Education, tools, and games for...
- **10:** Materials and longevity
- **11:** Clothing, footwear and accessories...
- **12:** Digital longevity
- Workshops

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WEDNESDAY

SESSION 1

ID: 161 | *Regular Paper*

KEYWORDS: Product attachment; Velskoen; Footwear; South Africa; Longevity

I feel more like myself when I wear my velskoene: Exploring South African male millennial consumers' attachment to their velskoene

Emmy Lombard, Hanri Taljaard-Swart, Bertha Jacobs

University of Pretoria, South Africa

Due to fast fashion, the lifespan of products like footwear has shortened, with consumers discarding shoes prematurely due to poor quality or for newer options. Extending the product lifespan through product attachment offers a potential solution. While product attachment studies have explored multiple product categories, few have focused on one product within a particular context. This study focuses specifically on the velskoen, a leather footwear style known for being durable and long-lasting. The velskoen has not been formally researched in South Africa, nor has its product attachment been explored. Therefore, the study aims to explore product attachment among millennial males in South Africa, specifically velskoen attachment. Qualitative, semi-structured interviews were conducted with ten participants and focused on four determinants of attachment: memories, pleasure, self-expression, and group affiliation. Object elicitation enabled participants to showcase their velskoene and comfortably chat about them to extract valuable insights. Participants described their memories, how their velskoene allowed self-expression, to which groups they affiliated themselves and their velskoene, the different types of pleasure their velskoene afforded, and product care practices. While memories featured strongly, physical pleasure emerged the most. More often than not, these two determinants complemented each other. Additionally, results showed that the velskoen allowed participants to express themselves and feel connected to specific groups on a cultural and national level. This suggests a notable attachment to velskoene among the male millennials in South Africa, which is linked primarily to pleasure and memories, which causes extended ownership, increased care, and improved sustainability.

ID: 311 | *Extended Abstract*

KEYWORDS: Transition design, Fashion, Wardrobe, Body change, Fashion practices

Connecting transition design and everyday fashion practices: a case of body change and the wardrobe.

Aniko Gal

University of Ferrara, Italy

This paper presents a reflection that is part of my doctoral project, which focuses on transitions related to fashion practices. Garments and fashion items are part of everyday life, and they are objects that accompany people through small and big moments of transition: between contexts, life phases, and body changes. The wardrobe transforms together with the body. For example, during pregnancy, garments need to be managed in order to always fit the transforming body. In this work, I introduce a connection between phases of the transition process and everyday fashion practices by describing a moment of body change from the perspective of dressing, aiming to offer a foundational reflection for further empirical and theoretical research.

ID: 158 | *Regular Paper*
KEYWORDS: #Wardrobechallenge, Wardrobe work, Sustainable behaviour change, User-generated content, Fashion communication

Wearing and sharing #wardrobechallenges: Finding inspiration when you have nothing to wear

Rachel Elizabeth Matthews
Manchester Metropolitan University, United Kingdom

Since the emergence of the fashion blogosphere, sharing of personal fashion choices and inspirations using hashtags such as #OOTD (outfit of the day) have become commonplace. The speed and volume of this content has grown exponentially, providing a mediated view of self-fashioning as well as a common trope of marketing communications adopted by influencers. Recently, there has been a noted change in the nature of wardrobe activities being shared on social media, that focus on the challenges fashion users have as they navigate their existing wardrobe. User-generated content (UGC) tagged with #wardrobechallenge draws together diverse posts ranging from how to re-wear wardrobe items through techniques such as the 30 wears challenge, struggles with closet decluttering and laundry tips. This type of wardrobe work is predominantly an activity undertaken in private; however, when shared and mediated through digital channels it offers greater visibility on the use phase of garments. Recognising that the use-stage holds much potential to extend the lifecycle of existing garments (Gwilt & Rissanen, 2012), this paper explores UGC to understand whether the sharing of wardrobe challenges holds potential to drive sustainable behaviour change.

ID: 109 | *Regular Paper*

KEYWORDS: Repair, circular economy, repair service, design strategies, consumer behaviour

Unveiling the Power of Repair Services in Enhancing Consumer Repair Behaviour in the Fashion Industry: A Crucial Step Towards a Circular Economy

Marie Das[1], Nasira Ahsan[1], Dirk Van Rooy[1], Els Du Bois[1], Ingrid Moons[2]

[1]Faculty of Design Sciences, University of Antwerp, Belgium; [2]Faculty of Business and Economy, University of Antwerp, Belgium

Advocates for reducing the fashion industry's ecological impact emphasize the importance of Circular Economy (CE) principles, with repair being a vital strategy for extending product lifetimes. The current research aims to go beyond merely identifying the factors that influence consumers' perceptions of repair services and their repair behaviour. It explores the types of repair services people prefer and presents actionable and practical design strategies that companies can adopt to facilitate their transition to CE. A quantitative survey (n=265) was set up to identify preferred repair services and factors influencing willingness to repair. Moreover, a focus group with experts (n=10), used the input generated by the survey to further discuss possible design strategies. The survey findings reveal that although consumers strongly support repair, few actually participate in it. While high costs are identified as a barrier, trust and respect for repair professionals serve as motivators for repair behaviour. Additionally, there is a clear preference for local repair services over those offered by fashion brands. The developed design strategies aim at increasing the visibility of repair services, enhancing consumers' repair skills, and leveraging trust in craftsmanship to improve perceptions of quality. The study concludes that improving repair service quality through these design strategies will extend the lifespan of clothing and footwear, crucial for the CE transition. Future research should explore the practical implementation of the proposed strategies and look for possible cultural differences.

ID: 292 | *Regular Paper*

KEYWORDS: Repairability, behavior, barriers, knowledge, socialization

Repairing the upbringing: Socialization and product repair behavior

Sophia Rytter Møller, Kamilla Strand-Holm Schmidt, Linda Nhu Laursen

Department of Architecture, Design and Media Technology, Aalborg University, Denmark

With growing concerns over sustainability and waste generation both globally and in Denmark, under-standing consumer behavior in product repair is crucial. This study investigates in-house product re-pair behavior in Danish households, focusing on the motivations, and barriers of repairs related to social upbringing. Data was collected as a mixed-methods approach, using 9 qualitative semi-structured interviews as primary data based on secondary picture data collection of self-repaired products from 30 Danes. The study confirms prior studies that show: lack of emotional value, eco-nomic feasibility, tools and knowledge as barriers for consumer repairs. Moreover, it contributes by adding multi-socialization during upbringing and types of knowledge, particularly informal repair knowledge from family members, as a crucial determinant in shaping repair behavior specifically re-lated to the knowledge barrier and motivation. This research sheds light on the nuances of Danish household repair behavior, suggesting the integration of repair education in schools and the utilization of repair cafés to foster a sustainable repair culture.

ID: 151 | *Extended Abstract*

KEYWORDS: Circular Economy, Design for Repair, Design for Recycling, Electronic Product Design, Resource Recovery

Designing Electronics for a Circular Economy: How to balance Repair and Recycling

Dorien C. van Dolderen, Doris L. Versloot, Soroush Aghaeian, Conny A. Bakker, Ruud Balkenende

TU Delft, the Netherlands

The short lifespans of electronic products contribute to significant resource losses. This research investigates the trade-offs between repairability and recyclability in electronic design by analyzing diverse products. Combining disassembly analysis and shredding experiments, the study evaluates how material choices and connection types influence recovery pathways. Findings reveal tensions between design for repair and recycling, emphasizing the need for balanced approaches to extend product lifetimes while improving end-of-life material recovery. The insights form the basis for a design guide that supports integrated circular strategies.

ID: 277 | *Extended Abstract*

KEYWORDS: Consumer repair; repair café; circular economy; well-being, fundamental human needs

The ReMake Cafes as a source of well-being: being, doing and interacting as motivations to participate

Angelina Korsunova, Piia Lundberg

University of Helsinki, Finland

The main goal of our study was to explore the range of motivations among residents of Helsinki to participate in ReMake café activities. While the literature on repair cafés often emphasizes the importance of repair cafes as communities for advancing citizen-driven progress in circular economy, our study brings forward additional aspects related to participation in repair and repurpose events, like improved well-being. Our analysis is based on the framework of fundamental human needs (Max Neef, 1991), which highlights how human well-being is dependent on different existential categories, including being, having, doing and interacting. In contrast to "having" as the main source of well-being, our study engages with other categories, such as being, doing and interacting as motivations to visit ReMake Cafes. The data consists of 16 qualitative interviews with participants of the ReMake cafes (individual and small group interviews), and insights from a short survey distributed among the participants of ReMake Cafes (n=63). Our findings showed that participants of ReMake Cafes often had mixed motivations that drew on categories of being, doing and interacting. For instance, on top of repairing (doing), many participants valued engagement with others (interaction) as part of the experience. Some participants came to ReMake cafes without any good to repair, as they wished to just be present in the event (being). The success of the ReMake cafe events in fulfilling the needs for being and interacting along repair indicates that it is important to consider these aspects in mainstreaming circular consumption practices.

ID: 175 | *Regular Paper*

KEYWORDS: Refurbished, Consumer, Attributes, Psychology, e-waste

Behind the Stars: Consumer Personality and Review Composition for New and Refurbished Products

Karthik Krishnan, Arunima Rana

Indian Institute of Foreign Trade, Delhi, India

The rapid growth of e-commerce and technological advancements has amplified the production of electronic waste (E-waste). Refurbished products offer a sustainable alternative by extending product lifecycles, yet consumer behavior toward these products remains underexplored in many regions, including India. This study investigates key product attributes and psychological characteristics of consumers, analyzing 2,189 refurbished and 4,967 new product reviews using text mining and linguistic analysis tools. The findings highlight significant differences in consumer preferences, with refurbished product consumers prioritizing Battery health, Service-related aspects, packaging, and hygiene, while new product buyers emphasize features and aesthetic factors. Psychological differences are evident as refurbished product consumers exhibit a more positive tone and goal-driven reasoning while new product consumers show more structured analytical evaluation. Using Constructive Decision-Making Theory (CDMT), the study explains how consumers of refurbished products construct satisfaction by reinforcing their choices post-purchase. The findings offer insights for refurbishers, policymakers, and marketers to foster trust and adoption of refurbished products through marketing strategy, standardized practices, and certifications while aligning with consumers' decision-making process.

ID: 211 | *Extended Abstract*

KEYWORDS: Mental Book Value, Lifetime Expectations, Replacement decisions, Sustainable consumer behavior, Electric appliances.

Understanding Mental Book Value: Exploring Replacement Decisions and Lifetime Estimations

Jelle Thomas Emiel Westervaarder[1], Ruth Mugge[1], Ellis Van den Hende[1], Marlene Vock[2]

[1]Delft University of Technology, Netherlands; [2]University of Amsterdam, Netherlands

A substantial number of electric appliances are replaced while still functional, contributing to environmental challenges. Despite retaining utility, consumers may perceive that such appliances have delivered sufficient value, leading to their replacement. 'time for a new product' is frequently observed as a primary motivator for such decisions. Replacement decisions consist of two interconnected processes: acquiring a new appliance and retiring the old one. This study draws on the concept of mental book value to examine how consumers' lifetime estimations influence when consumers determine that it is 'time for a new product'. Preliminary analysis of 20 interviews participants revealed that electric appliances' mental book value are fully written off once these have met consumers' lifetime estimations. Moreover, this research enhanced the understanding of the mental book value depreciation and lifetime estimations, providing a deeper understanding of how these factors influence replacement decisions. By addressing these dynamics, strategies can be developed to extend appliance lifetimes, reduce waste, and promote more sustainable consumer behavior.

ID: 240 | *Extended Abstract*

KEYWORDS: Consumer electronics, epistemic value, novelty, product lifetime, sustainable consumer behavior

Design Strategies to Strengthen Epistemic Value in Consumer Electronics and Prolong Product Lifetime

Hanchu Sun, Giulia Granato, Ruth Mugge

Delft University of Technology, Netherlands

The consumer electronics waste has become a serious environmental concern (World Health Organization, 2024). A significant factor driving this issue is "premature obsolescence," which refers to the premature discontinuation of a product use or the premature replacement of a functioning product with a new one (Magnier & Mugge, 2022; Ylä-Mella et al., 2022). Current consumer replacement theory attributes this phenomenon to psychological value trade-offs, where consumers prematurely value new products over their current ones (Van den Berge et al., 2021). This shift is often driven by an attraction to novel features, updated designs, and the overall sense of novelty offered by new products on the market, while their owned devices increasingly lose appeal due to familiarity and boredom (Echegaray, 2016; Van den Berge et al., 2021). Although existing research highlights the importance of preserving the perceived value of owned products to combat premature obsolescence (Magnier & Mugge, 2022; Van Nes, 2016), effective design strategies are underexplored. This study aims to explore design strategies to preserve value of owned consumer electronics, focusing on strengthening their epistemic value to prolong product lifetime and reduce waste (...)

ID: 166 | *Extended Abstract*

KEYWORDS: Electronic goods; Product obsolescence; Life-span trends; Consumer behaviour

Have prospects for product life-spans improved? A comparison of trends in household appliances and electronic goods over 25 years

Tim Cooper[1], Matthew Watkins[2], Maryam Bathaei Javareshk[1,3], Thom Baguley[1]

[1]Nottingham Trent University, Nottingham, United Kingdom; [2]Loughborough University, Loughborough, United Kingdom; [3]Cranfield University, Bedford, United Kingdom

The lack of firm evidence on trends in the lifespan of consumer durables is especially unfortunate in the case of household appliances and electronic goods due to the scale and environmental impact of e-waste (Balde et al., 2024). Although some limited international data on product life-spans was identified over 40 years ago (OECD, 1982), research to generate data systematically across all types of household appliances and electronic goods was only undertaken much later. (...). This Extended Abstract compares data from the two UK surveys on the ownership of household appliances and electronic goods, their lifespans, and the extent of rental, reuse, borrowing and sharing. Future outputs will draw upon the substantial new database to address themes such as consumer expectations, public policy, demographic influences, design influences and repair.

ID: 156 | *Extended Abstract*

KEYWORDS: EEE; LCA; Circular Economy, Remanufacturing

Life cycle assessment (LCA) of remanufactured electrical and electronic products; a review of methodological choices

Keteki Anand[1], Yvonne Ryan-Fogarty[2], Colin Fitzpatrick[1]

[1]Department of Electronic and Computer Engineering, University of Limerick, Limerick, Ireland; [2]Department of Chemical Sciences, University of Limerick, Limerick, Ireland

Life Cycle Assessment (LCA) is a crucial tool for evaluating the environmental impacts of products throughout their life cycle. This review examined the methodological choices inherent in LCA studies of remanufactured electronic and electrical equipment (EEE), focusing on system boundaries, functional unit, allocation methods, inventory data sources and results. The review highlighted the lack of transparency in reporting methodological choices in a significant number of studies. It was further demonstrated how these decisions, particularly through the use of neutral and supportive perspectives in allocation and system boundary selection shaped the perceived environmental benefits of remanufacturing. Notably, the review illustrated how certain methodological approaches led to a significant reduction in global warming potential. The findings also emphasised the advantages of remanufacturing electrical and electronic equipment, although only two studies explored the potential rebound effects. Moreover, the review identified the existing gaps and provided valuable insights for standardising LCA methodologies and improving their applicability for remanufactured EEE. The findings highlighted the critical importance of aligning LCA approaches with the specific characteristics of remanufacturing systems, thereby supporting sustainable decision-making and policy development in the electrical and electronics sectors.

ID: 197 | *Extended Abstract*

KEYWORDS: Lifetime Modeling, Functional Unit (FU), LCA, Durability, Consumer Behavior

Exploring Lifetime Approaches in Life Cycle Assessment of Textiles and Footwear

Agata Costanzo[1,2], Marco Frey[1], Monia Niero[1]

[1]Sant'Anna School of Advanced Studies, Interdisciplinary Center on Sustainability and Climate, Pisa, Italy; [2]University of Padova, Department of Industrial Engineering, Padova, Italy

The European Union is prioritizing the development of sustainable production and consumption regulations, with textile and footwear identified as a hot sector due to its challenges, including those posed by fast fashion. In this context, Life Cycle Assessment (LCA) plays a critical role, being a powerful tool to compare the potential environmental impacts of products. A key factor for LCA studies is the functional unit (FU) definition, which aims to define the product's specific function and quantify related flows, and environmental profile. The quality (How well?) and lifetime (How long?) dimensions of the FU, however, are challenging to represent for textile and footwear products, since they depend on variables such as consumer behavior, material durability, and fashion trends. This study reviews how product lifespan has been modeled in LCA studies of textiles and footwear. A literature search identified 17 relevant studies, that were then categorized and analyzed. Four lifetime modeling approaches were identified, defining lifespan by i) care cycles, ii) combining the number of wears and care cycles, iii) years of use, and iv) durability derived from intrinsic product properties. Each modeling approach is briefly discussed and analyzed. Findings reveal the lack of comprehensive models fully integrating the number of wears, service lifespan, and durability features. Durability-based methods, which assess lifespan through product performances, are underutilized but could improve LCA accuracy by addressing intrinsic product properties.

ID: 202 | *Regular Paper*

KEYWORDS: Product life cycle; Scope 3; Value Chain; Science-based Targets; Absolute Sustainability.

Mind the gap: To what extent are Danish early adopters of science-based targets addressing impacts across their products´ life cycles?

Astrid Birk Nicolajsen[1,3], Anders Bjørn[2,3], Tim C. McAloone[1,3], Daniela C. A. Pigosso[1,3]

[1]Section of Design for Sustainability, Department of Civil and Mechanical Engineering, Technical University of Denmark, Kongens Lyngby, Denmark; [2]Section for Quantitative Sustainability Assessment, Department of Environmental and Resource Engineering, Technical University of Denmark, Kongens Lyngby, Denmark; [3]Centre for Absolute Sustainability, Technical University of Denmark, Kongens Lyngby, Denmark

Value chain emissions constitute the largest share of most company's greenhouse gas (GHG) inventory, making their reduction essential for achieving science-based targets (SBTs) and supporting global climate goals. This study analyses the decarbonization efforts of six Danish early adopters of SBTs, focusing on their strategies to reduce emissions across product life cycles and value chains. Based on publicly disclosed data from company reports and responses to the CDP Climate Change Questionnaires, the findings reveal a primary focus on Scope 1 and 2 emissions, with limited efforts targeting value chain emissions (i.e., Scope 3) during the early years following target setting. The study highlights significant gaps between the reductions required to meet targets and the reported impact of current and planned strategies, with shortfalls ranging from 17% to 75% of current inventory levels. Additionally, the study highlights inconsistencies and gaps in company disclosures making it difficult to assess actual progress. To close these gaps, there is a need for more knowledge on how companies can accelerate value chain decarbonization - such as through circular economy strategies - and improved transparency in reporting. Enhanced corporate action and disclosure are critical to aligning with SBT commitments and ensuring meaningful climate progress.

ID: 291 | *Regular Paper*

KEYWORDS: Furniture, Product Longevity, Emotional Attachment, Value, Convenience

Convenience as a Key Driver in Extending the Cumulative Lifespan of Furniture

Anna Kieu Nguyen, Clara Olivia Birkekær Christiansen, Frida Elmstrøm Therkelsen, Andreas Kornmaaler Hansen

Aalborg University, Denmark

In response to environmental challenges and overconsumption, design strategies focusing on product longevity have emerged. While product longevity is partly determined by physical durability, it is also heavily influenced by the consumer. Therefore, understanding consumer attitudes toward product lifespans is essential for gaining insights into longevity. Specifically, this study investigates how consumers' valuation of furniture impacts its lifespan. The findings are based on data from semi-structured interviews and a survey provided by AAU Design Lab, analyzed through reflexive thematic analysis. The study introduces two terms to further specify the understanding of product lifespan: individual ownership lifespan and cumulative lifespan. The study found that emotional attachment is not necessarily essential for achieving prolonged cumulative lifespan of furniture, challenging existing strategies like design for attachment and emotional durability. While these strategies influence individual ownership lifespan, the findings in this paper suggest that convenience is the key driver in extending the cumulative lifespan of furniture by enabling its reuse through accessible disposal methods and platforms. Accordingly, putting a stronger focus on the systems and contexts in which products exist could play an important role in extending their lifetime. As this is a preliminary study with limited data, these findings should be considered an interesting starting point for further investigation.

ID: 316 | *Regular Paper*

KEYWORDS: Digital Product Passport, Product Lifetime Extension, End-of-Life Management, Sustainability

Development of a Digital Product Passport for iPads to Enhance Student Sustainability Practices

Junwon Ko[1], Nnaemeka Okafor[1], Fazleena Badurdeen[1], Peng Wang[2]

[1]Institute for Sustainable Manufacturing (ISM) and Department of Mechanical & Aerospace Engineering, University of Kentucky, Lexington, USA; [2]Mechanical & Aerospace Engineering, Case Western Reserve University, Cleveland, USA

This paper proposes a generic framework for the design and development of Digital Product Passports (DPPs) applicable across various products, sectors, and developers. The framework, established considering information requirements and existing approaches identified in DPP literature, comprises four key phases: (1) Defining the Foundations; (2) Design and Development; (3) Testing and Refinement; (4) Deployment and Evaluation. Its application is demonstrated through the development of a Digital iPad Product Passport for the University of Kentucky iPad initiative (UK-DiPP). An app-based UK-DiPP prototype is presented with three core intended functionalities: (1) Charging Pattern, (2) Battery Usage, and (3) iPad Lifecycle, aiming to promote sustainable charging practices, extend battery lifetime, support end-of-life (EoL) management, enhance sustainability awareness on campus, and mitigate the negative environmental impacts associated with iPad use and disposal. Challenges as a third-party DPP developer, including limited data accessibility and technical obstacles, are discussed with potential workarounds and solutions. This research contributes to the practical development and implementation of DPPs by offering a versatile framework and showcasing real-world application.

ID: 332 | *Extended Abstract*

KEYWORDS: Social sustainability, social impact analysis, engineering education, sustainable product design

Navigating social sustainability in engineering education: student experiences and challenges of using a social impact audit tool in a product design project

Giliam Dokter, Plinio Fernandes Borges Silva, Jonas Tuveson, Peter Hammersberg

Department of Industrial and Materials Science, Chalmers University of Technology, Sweden

The social dimension of sustainable development is crucial for achieving the first five Sustainable Development Goals (SDGs), yet it remains underexplored in product design. Despite the growing importance of social sustainability, design support for assessing social impacts in product concepts is limited, and the social pillar remains the least developed in engineering education. Understanding social impacts is key to ensuring that product interventions promote inclusivity, equity, and societal wellbeing, especially in the context of extending product lifetimes. This paper explores the challenges faced by industrial design engineering students at Chalmers University of Technology while using the Social Impact Audit Tool (SIAT) by Ansys in a bachelor-level sustainable product development course. The tool ranks social impacts along production chains, supporting designers in making informed, socially conscious decisions. The study found that students recognized the tool's value in assessing social impacts but struggled with defining acceptable impact thresholds, balancing sustainability trade-offs, ensuring data reliability, and prioritizing social categories. Workshops indicated that while the tool facilitated a systematic approach to analyzing social impacts, it also highlighted the importance of users critically assessing the data sources and complexities of social sustainability. Further research is needed to study the tool and implications further, and address the risks of oversimplifying social impacts, while emphasizing the potential opportunities to enhance social sustainability.

ID: 344 | *Regular Paper*
KEYWORDS: Waste management; entrepreneurship; environment; sustainability; innovation; social

Entrepreneurship and Waste Management: Cultivating Sustainable Solutions Through Education

Sweta Patnaik, Shamil Isaacs
Cape Peninsula University of Technology, South Africa

This paper examines the critical intersection of waste management and entrepreneurship within the context of sustainability-focused education, emphasizing the importance of integrating these themes into academic curricula to address pressing global environmental challenges. As the world grapples with issues such as resource depletion, excessive waste generation, and unsustainable business practices, the transformative role of education becomes increasingly evident. This study highlights how equipping students with the knowledge, skills, and entrepreneurial mindset to innovate for sustainability can be a powerful catalyst for change. Central to the discussion is advocating for teaching on, about, and sustainable development. The paper proposes a multidimensional pedagogical approach that combines theoretical understanding with practical application, fostering critical and innovative thinking. By integrating principles of waste reduction, circular economy, and sustainable supply chain management into interdisciplinary learning experiences, the approach empowers students to identify and act on opportunities to drive environmental improvement. The paper also explores the role of experiential learning methodologies, such as problem-based learning, design thinking, and value co-creation, in fostering collaboration across disciplines and engaging stakeholders. By doing so, it seeks to prepare the next generation of environmentally conscious entrepreneurs capable of addressing waste management challenges while contributing to a more sustainable future.

ID: 184 | *Extended Abstract*

KEYWORDS: Evolving toys, Adaptability, Half-way design, Open-ended play, Toy longevity

Design for Evolving Play: Exploring Levels of Adaptability in Toy Design

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The short lifespan of children's toys, driven by rapid child development and a desire for novelty, results in significant resource loss and waste. Research suggests open-ended and emotionally durable toys tend to last longer. Addressing this issue, this study explores how evolving and open-ended toys can be designed adopting half-way design approach and design considerations enabling evolvability in toys for longer lifespans. A toy design project was conducted with third-year industrial design students to create 3D-printed connectors for personalised and evolving toys. These connectors were designed to integrate with household waste materials like cork and cardboard, promoting personalisation, upcycling, and adaptability. Eight students developed five toy kits, which were analysed through visual content analysis to explore how they could be adapted in the design and use phases. Four adaptability levels were identified: surface, form, function, and structure. Functional adaptability emerged as the most critical for open-ended play and longevity. Part variety and versatile design details were found to be the significant design attributes that facilitate evolvability and open-ended play.

ID: 196 | *Regular Paper*

KEYWORDS: Timber building, End-of-life modelling, Design for Deconstruction and Reuse, Reference service life, Temporary carbon storage

Revising regulations unleashes engineered timber buildings potential for climate mitigation

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Engineered timber can substitute traditional carbon-intense building materials playing a critical role in climate action thanks to its capacity to store biogenic carbon removed from the atmosphere during forest growth. However, the existing regulations and standards developed in the past along with the development of traditional building practices based on concrete and steel, hinder the possibility to fully exploit the potential of engineered timber within the construction sector. Current standards impose 50 years as reference service life for buildings. While irrelevant for traditional materials, which are not carbon stocks, this imposition belittles this unique feature of timber-based materials. Furthermore, current standards for timber-based materials impose well-defined End-of-Life (EoL) scenarios, each culminating with the incineration of the timber – regardless of any cascading process. However, among the possible EoL scenarios, the possibility of reusing engineered timber materials maintaining the same function is not conceived, although technically feasible. Consequently, LCA of buildings following such standards are forced to neglect the potential positive impact of timber-based buildings possibly providing results that tend to favor traditional over timber-based materials. In this work, we show the potential of timber-based buildings to act as a mean of climate mitigation, calling for an urgent modification of the current standard and linked LCA practices. The case study of a timber-based multi-story building shows that RSL extension and reuse reduce the emission by 13% and 1-2% respectively compared to concrete, except for a RSL of 150 years for which the reduction is marginal.

ID: 251 | *Extended Abstract*
KEYWORDS: Circular Economy, R-Strategies, Product Design, Sustainable Design

Design for Circularity (DfCE) – How to Align Product Requirements With R-Strategies to Enhance Circular Economy on an Operational Level

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The circular economy redefines resource utilization and waste management, with R-strategies serving as guiding principles toward sustainability objectives. Understanding how each R-strategy influences product design, lifecycle, and end-of-life handling is crucial for aligning product development with circular economy goals. However, existing studies are either product-specific or too generic, lack a common definition of R-strategies and sub-categories, and do not investigate interconnections between design for circularity (DfCE) sub-categories. This study explores how R-strategies shape product requirements, such as durability, reparability, and modularity, and identifies the role of design considerations in enhancing product circularity. A systematic literature review following PRISMA guidelines yielded 77 relevant articles from an initial 767. Using inductive coding and network mapping, we identified 45 DfCE sub-categories covering all 10 R-strategies and condensed over 1,000 product requirements into about 600 final requirements. Analysis shows different R-strategies associate with distinct product requirements; for example, remanufacturing emphasizes accessibility, disassembly, and update capability, while reduce focuses on waste elimination and dematerialization. These findings highlight how R-strategies influence product requirements, indicating the need for design considerations tailored to each strategy. Synthesizing and standardizing guidelines into a common framework, this study offers a structured approach to integrating circularity into product design. This enables designers to prioritize attributes aligning with desired R-strategies, enhancing effective circular economy implementations. Future research should develop standardized metrics to assess adherence to R-strategies at the product requirement level and investigate practical applications of the guidelines in industry.

ID: 287 | *Regular Paper*
KEYWORDS: Circular economy, CE indicators, CE metrics, Design for Recycling, Design for environment

Novel methodology for the selection and evaluation of R-strategies to support product design for circular economy

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EU legislation demands manufactures to improve their product's circularity. The 9R Framework organizes strategies of a circular economy in a hierarchical manner based on their respective effectiveness in promoting circularity. Manufacturers need to determine which of these strategies can be implemented for their products and how well a certain design meets the requirements of these strategies. Therefore, a methodology is proposed allowing to identify feasible R-strategies that are appropriate for a specific type of product. In the next step, the methodology evaluates how the unique characteristics of a particular component allow for the application of these strategies. This methodology is applied to a case study of a vehicle door, considering and comparing the circularity readiness of various design variants. A set of specific Circularity-indicators (C-indicators) for each strategy is used for this purpose. This methodology enables comparisons among different design options, highlighting their impact on the product and material recyclability. Ultimately, the methodology helps to identify challenges in a targeted manner that guide designers in creating products that effectively support beneficial R-strategies.

ID: 257 | *Extended Abstract*
KEYWORDS: Circular design, circular economy, co-creation

Implementing circular design strategies through co-creation: An action-research case in the household goods sector

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This study examines how co-creation can facilitate the adoption of circular design strategies in product development, including longer-lasting products, repair, and refurbishment. The research was conducted in collaboration with a multinational company producing small household goods. The goal of this research was to explore how the co-creation process can support the implementation of circular design strategies in the product development process.

WEDNESDAY **ROOM 3.107**

ID: 264 | *Extended Abstract*
KEYWORDS: Co-creation, Experience, Skill, Transformational Knowledge, Empowerment

Employing Pedagogy in the Experience Economy to Extend Product Lifetimes

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Within the experience economy, personalisation has been marketed as a method to increase the rate and quantity of consumption (Kuksa et al 2022), however this research rather highlights opportunities to reduce the environmental impact of consumption and to extend product lifetimes by viewing the co-creation space as a site of learning. Co-creation experiences engage consumers in the making of their products and, through this, are well positioned to deepen an understanding and appreciation of the material world. Drawing upon pedagogic theory, in particular Meyer & Land (2003)'s idea of 'transformational knowledge', and Vygotsky's 'scaffolding' (1978), this research will explore how making experiences can provide individuals with the skills and confidence to fix, repair and maintain objects they own. It will aim to analyse the collateral impacts of a co-created product, beyond a Product Life-Cycle Analysis and towards a more holistic view of shifts and changes that may occur in wider patterns of consumption, care and maintenance for an individual empowered by a learning experience. Where this knowledge is embedded in a community setting it will seek to explore how peer-to-peer support can encourage increased environmental stewardship and personal responsibility.

ID: 123 | *Regular Paper*
KEYWORDS: Second-hand products; skill acquisition; expertise; consumer; thrift shopping

Not Just Luck: Uncovering the Secret Skills and Expertise of Second-hand Shoppers

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While second-hand markets are rapidly growing, consumers still find it difficult and challenging to purchase second-hand, as the shopping experience is more messy, complex and unpredictable. In this paper, we study second-hand shopping as an expertise that can be practiced. We investigate the process of skill acquisition to understand the skill development of shopping second-hand. Based on a pilot study with 20 semi-structured interviews and a focused study with 14 interviews, this research illustrates a progression in second-hand shopping behaviors as individuals gain experience. This study categorizes second-hand shopping expertise into six levels, highlighting distinct behaviors and strategies. We find: 1) Novices are overwhelmed, lack confidence, and rely entirely on others to assess quality and price. 2) Initiates show narrow focus on specific products and apply external expertise, but struggle to broaden their scope. 3) Apprentices use structured strategies, targeting pre-researched items and avoiding unstructured second-hand environments. 4) Journeymen demonstrate proficiency within select product categories, researching brands and quality indicators to compare items with nuanced criteria. 5) Experts possess deep but abstract knowledge of product quality and durability, allowing them to identify high-resale potential items without prior research while maintaining frequent, informed engagement with second-hand markets. 6) Masters showcase comprehensive expertise, relying on intuition, ingrained knowledge, and fast-browsing techniques to navigate diverse product categories effortlessly. These findings offer a framework for improving second-hand shopping skills across expertise levels.

ID: 153 | *Regular Paper*
KEYWORDS: Product circulation, Reuse enabler, Consumer, Second-hand product, Product divestment

Turning Trash into Treasure is Hard Work! How The Activities of Consumers and Reuse Enablers Extend Product Lifetimes

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This paper explores the process of transferring second-hand products from one home to another. It focuses on three key participants: the consumer who is divesting products from their home, the consumer who purchases pre-owned items, and the second-hand and reuse enablers that facilitate this circulation of products. Current literature tends to concentrate solely on one of these groups—either consumers divesting products, second-hand and reuse enablers, or consumers buying pre-used items. This fragmented approach leaves gaps in understanding the complete process of product circulation. To address this knowledge gap, our study examines the entire process, starting from the moment a consumer decides to part with a product until that product finds a new owner. We conducted interviews with 20 consumers who are divesting products, 11 second-hand and reuse enablers, and 20 consumers who purchase pre-owned items. Through our research, we identified three main product circulation processes and eight sub-processes: Donation, Commission Sale, and Sell-It-Yourself. Each circulation process involves a series of activities carried out by the consumer divesting the product, the reuse enabler, or the consumer buying the item. By comparing these processes, we highlight that successful circular product exchanges require significant effort from all participants. Additionally, we demonstrate how the responsibility for these activities shifts depending on the chosen process, revealing the challenges and potential pitfalls associated with circular product transactions. This research contributes to a deeper understanding of the circular economy and its current struggles and opens discussions on how to overcome these challenges.

ID: 328 | *Extended Abstract*
KEYWORDS: Emotional Value, Prolonged Use, Early Replacement, Consumer Electronics, Electronic Waste

Vulnerabilities of Design Strategies for Retaining Emotional Value in Consumer Electronics

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Prolonging the use of consumer electronics is essential to mitigate the environmental and health impacts of e-waste. While repair and reuse have received considerable attention, products are often replaced prematurely for reasons beyond functionality, influenced by trade-offs between functional and emotional values. Emotional value, a product's ability to evoke positive emotions and affective states, can significantly delay replacement and extend product lifetimes. However, current design strategies intended to foster emotional value often fail during product ownership due to several vulnerabilities. This study identifies five key vulnerabilities affecting emotional value retention in consumer electronics: user-specific, product-service system (PSS)-related, organizational, technical, and market-driven. User-specific vulnerabilities include insufficient pre-purchase awareness and post-purchase attention to emotional value-supporting product features. PSS-related vulnerabilities arise from poorly integrated digital and physical features, creating fragmented user experiences. Organizational vulnerabilities, such as resource limitations and conflicting priorities, reduce the adoption and quality of emotional value strategies. Technical barriers, such as limitations in modularity, lead to poor execution of these strategies. Market-driven vulnerabilities, driven by market and technological trends emphasizing novelty, erode the emotional value of owned products, making them feel outdated.This research advances theoretical understanding and offers practical insights for sustainable design by exploring these vulnerabilities across the critical stages of ownership. It emphasizes the need to address vulnerabilities in emotional durability strategies, enabling products to accommodate shifting consumer emotions over time. The findings support the development of design practices that retain emotional value, extend product lifetimes, and reduce e-waste.

ID: 207 | *Regular Paper*

KEYWORDS: Fast Furniture, Lifetimes, Value, Consumer Behaviour, Consumption.

How 'Fast' is Fast Furniture?

Katryn Furmston, Naomi Braithwaite

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This paper explores the emerging concept of fast furniture, a rapidly growing sector characterized by quick production, low costs, and short product life cycles. Despite its substantial environmental impact, fast furniture remains underexplored in academic literature. Drawing parallels to fast fashion in its focus on trends, disposability, and mass production, this study examines the intersections of consumer behaviour, industry practices, and sustainability challenges within the context of fast furniture. Through a mixed-methods approach, combining a quantitative/qualitative survey of UK consumers and interviews with industry professionals, the study reveals significant insights into consumer perceptions, motivations, and the role of fashion-driven consumption in shaping the furniture market. Key findings indicate that while consumers increasingly engage with trend-driven furniture purchases, many are unaware of the term "fast furniture." Moreover, despite their significant market share, brands like IKEA are not strongly associated with the "fast" model by consumers, who instead view their products as affordable and functional, yet temporary. Industry professionals, meanwhile, emphasize that the "fastness" of furniture is determined largely by consumer choices, not necessarily the manufacturing process. This research contributes to the growing body of knowledge on sustainable consumption, advocating for a broader understanding of fast furniture as a consumer-driven phenomenon rather than an industry-defined product category. Future research is suggested to further explore the global dynamics of fast furniture consumption, the role of consumer education, and sustainability initiatives within the industry.

ID: 139 | *Regular Paper*

KEYWORDS: Nudging, Rebound effects, Design for sustainability, Sustainable behaviour

Nudging as a strategy to prevent behavioural rebound effects in the early phases of design

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Despite the recognition that ca. 50% of the potential environmental gains of sustainability-oriented interventions are offset by rebound effects (RE), effective strategies that can prevent the occurrence of rebound effects are currently missing. To address this gap, this paper explores how nudging can be used to prevent RE during the early phases of design of products, product/service-systems and socio-technical systems. Through a Systematic Literature Review, 23 nudges that have the potential to promote sustainable behaviour were identified and subsequently classified into four categories: 'Decision information' (e.g. descriptive norms), 'Decision structure' (e.g. defaults), 'Decision assistance' (e.g. pre-commitment), and 'Miscellaneous' (e.g. priming). The identified nudges served as the foundation for the development of a novel design tool that can support the selection of nudges to prevent RE in the early phases of design, with indication of potential additional RE emerging from the implementation of the selected nudges. In addition to the development of the tool, this study mapped existing research gaps that can guide further research in the field.

ID: 144 | *Extended Abstract*

KEYWORDS: Product longevity; clothing; environmental impacts; literature review

The limitations of product longevity. Are longer product lifetimes really better for the environment?

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This contribution examines the shortcomings of product lifetime extension (PLE) as a strategy to reduce environmental impact, building on a recent literature review by the authors. Using clothing as an example, the study questions whether PLE might instead increase environmental impacts.The literature on the environmental impact of PLE assumes that new product demand is driven by replacement-based consumer behavior and that production decisions are solely influenced by consumer demand. However, replacement behavior is rare, and longer product lifetimes do not yield the anticipated environmental savings. This mismatch suggests that the assumed benefits of PLE in reducing production may not significantly apply to clothing, and there is a general lack of knowledge on how these behaviors vary across product groups, industries, and users. In fact, the impacts might increase due to accumulation and policies aiming to make products more durable. The discussion calls for empirical research to bridge the gap between PLE's environmental ambitions and actual behaviors, starting with the dynamics of inflow, outflow, and stock of products such as clothing.

ID: 215 | *Extended Abstract*

KEYWORDS: Rebound effect, circular economy, business models, design tools

The rebound mechanisms identification tool: finding rebound effects in circular economy business models

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This paper presents a rebound mechanism identification tool to help designers systematically find rebound effects (RE) in circular economy business models (CEBM). The tool is based on the dynamics between CEBM patterns and rebound mechanisms. This paper describes the steps for using the tool. It demonstrates its use in one case (i.e., Bundles, a washing machine as a service solution) while comparing the results to a previous case study following a manual procedure. The tool helps identify consumption factors applicable to a specific CEBM, holding the potential for fast and consistent identification of relevant rebound mechanisms.

ID: 306 | *Regular Paper*

KEYWORDS: Durability; Rebound effects; Product Environmental Footprint; Textile Literacy

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

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This paper takes its departure 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, it 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 of 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.

ID: 164 | *Regular Paper*
KEYWORDS: Product lifetime; Functionality; Energy-related Products; Purchase Decisions; Circular Economy

"Oh no, it's broken!" – How product functionality limits lifespan

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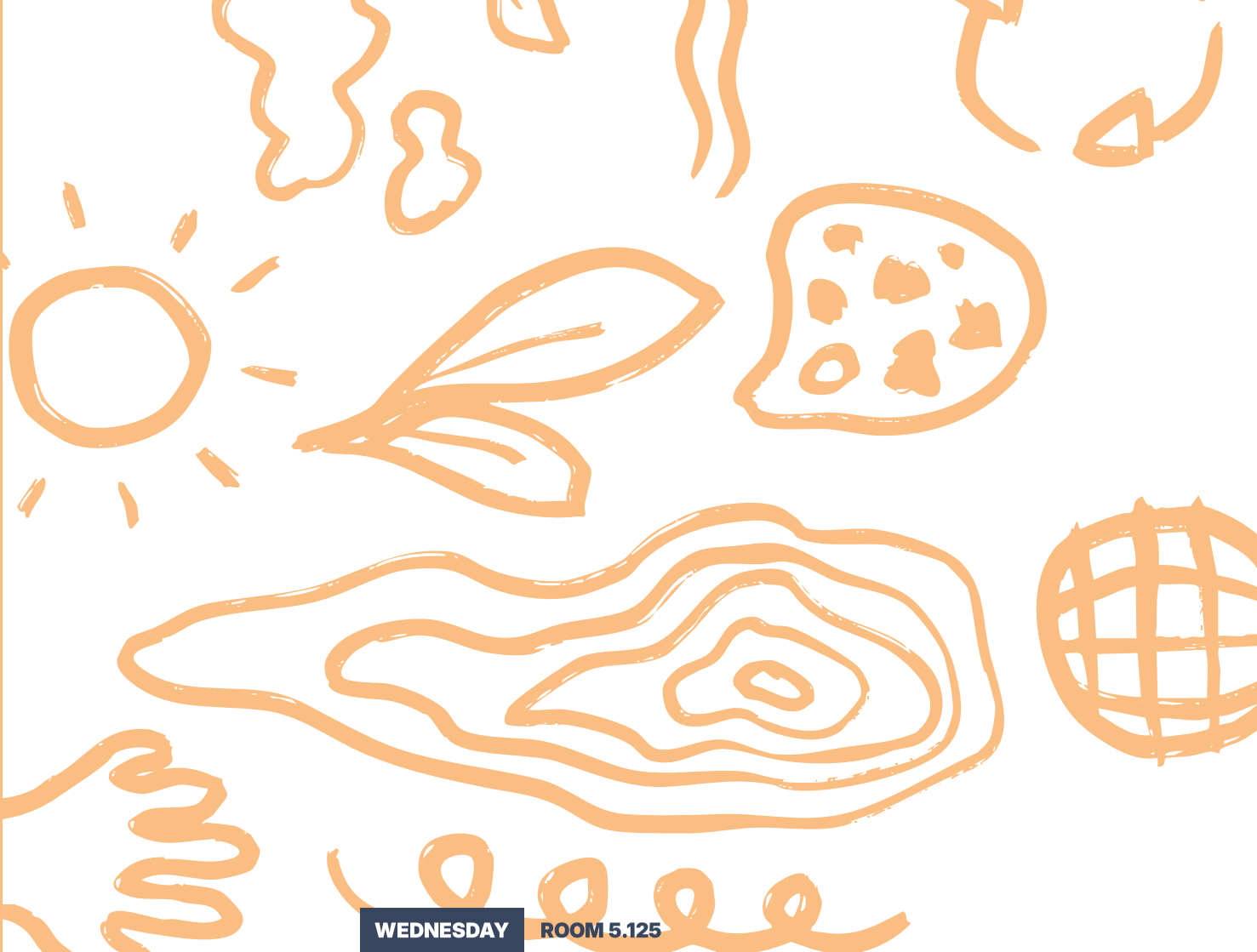
Today a large variety of products with various features and designs are available for consumers. In addition to the main functions of a product, there are more and more additional functions, especially for electrical and electronic appliances. This means that looking for the right product may require extensive research by consumers and does not always lead to a sense of making an informed purchase decision. The wide variety of designs and functions can overwhelm consumers. This creates uncertainty and might lead to overrate products functionality and thus significantly shorten the service lifetime of appliances. Furthermore, the environmental impact of such functions is usually unclear, and can vary depending on the actual usage scenario. In this study, a survey was carried out in order to better understand consumers perceptions and experiences related to additional functions of products, with specific focus on domestic hobs, household refrigerating appliances and televisions. The results confirm the large number of additional functions and their overwhelming effect for consumers. Consumers purchase devices with more features than desired, or replaced them prematurely because an extra feature fails while the main function is still available. The findings of the study can be used to better inform consumers and support them to make environmentally sustainable purchasing decisions.



WEDNESDAY ROOM 5.125

ID: 180 | *Extended Abstract*

KEYWORDS: Apparel; LCA tool; Reuse; Macro level; GHG emissions

Environmental Impact factors for Apparel Products: Generalizing LCAs with Statistical "Market-mix" Modeling

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Life Cycle Assessment (LCA) is a bottom-up approach widely considered the gold standard for assessing the full lifecycle environmental impacts of products or services. In the apparel sector, process-based LCA is commonly used by to quantify impacts of products or assess the potential benefits of different circular business models and strategies such as reuse and sharing. Since conducting LCAs is both time consuming and expensive, researches often rely on case studies as proxies for entire product populations in macro level assessment. This is problematic as process based LCA results are known to be case specific. Here, we build on data on the frequency, weights, and material composition distributions for apparel items in the EU, to build a dedicated open access Brightway based calculator, and generate environmental impact factors for a generic item in each apparel product category. Our results, based on the market mix approach can serve as benchmarks or help researchers advocacy groups and the general public when evaluating policies, running scenarios, and addressing incomplete data in aggregate datasets. Importantly, all parameters of materials, weights, and relative frequency can be adjusted and updated by users, to reflect aspects such as localize parameters for to a particular region or changes in apparel product populations over time as these become available. By simplifying complex systems, our approach and results enable actionable insights without relying on exhaustive, product-specific analyses.

ID: 259 | *Regular Paper*

KEYWORDS: LCA; Garment; Lifetime; Care index; Washing cycles

The Laundry Care LCA project

Stefano Zuin[1], Vsevolod Dengin[2], Valentina Perzolla[1], Francesca Bisaro[1], Mario Michele Pipita[1], Alberto Azzano[1], Fabio Garzena[1], Elisa Stabon[1]

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The fashion industry is increasingly scrutinized for the environmental footprint it generates. Despite this, less attention is placed on the possibility to reduce part of this footprint thanks to attitudes and daily actions that users can take in their homes. A life cycle assessment of three selected garments was performed to analyze the potential environmental benefits of an extended usage of garments thanks to the utilization of different washing treatments. Results showed that the garment production phase has consistently the highest impact. Within the use stage, the relevance of wash cycles was investigated by comparing various cycles in both the European and North America regions, and by highlighting the contribution of different energy mixes and detergent types. The data demonstrated that washing machine users can reduce the impact of garments by, for example, washing them at lower temperature, as this results in slower deterioration. Therefore, the environmental impacts per wear of garments can be reduced by around 50% by doubling the expected number of garments uses.

ID: 273 | *Extended Abstract*

KEYWORDS: Durability, Lifespan, Textile testing, Clustering, Textile industry

Test less, better, faster, cheaper.

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The textile industry faces significant socio-environmental challenges, particularly regarding the physical durability of products. Current durability assessment methods, based on standardized tests, are resource-intensive. This study proposes a methodology based on the clustering of quality data to optimize this process by reducing redundant tests and streamlining the selection of fabrics to be tested. The approach employs clustering techniques to analyze quality data and predict the dimensional behavior of fabrics. This methodology improved the prediction accuracy of quality test results and highlights the most influential characteristics, thus reducing costs and resource consumption while ensuring reliable results. It also supports an eco-design approach. This methodology opens the way for more efficient durability assessments, minimizing testing efforts without compromising reliability.

ID: 268 | *Extended Abstract*

KEYWORDS: Circular economy; Fashion & textiles; Regional strategies, End-of-life phase; Waste management

Beyond Recycling and Waste Export: Regional System for Post-Consumption Textile Circularity

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The textile industry faces critical environmental and social challenges, driven by overproduction, shortened garment lifespans, fragmented global value chains, and limited recycling capabilities. While material ecoinnovations, such as bio-based and recycled fibers, have gained prominence, even among fast fashion companies, their effectiveness in transforming the current unsustainable model remains insufficient without systemic changes. It is crucial to explore how social, local, and systemic innovations, as well as the regionalization of the fashion value chain, could deliver greater environmental, economic, and social benefits. This research investigates the potential of integrating ecoinnovations with circular strategies to address the sustainability challenges in the textile sector. It evaluates material-focused innovations alongside localized social initiatives, ranking these ecoinnovations based on their overall environmental, economic, and social impacts using life cycle assessment (LCA) criteria. The objective is to emphasize that material innovations alone cannot effectively mitigate the negative consequences of declining product and material lifespans, overproduction, and mass consumption in a fragmented global value chain. Instead, localized circular models offer greater potential by extending product lifespans and reducing consumption.

ID: 135 | *Extended Abstract*
KEYWORDS: Ecolabels; Eco-credentials; Sustainability; Textile fashion industry; Transparency

Ecolabels in the Textile and Fashion Industry: Strengths, Weaknesses, and Recommendations for Improvement

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The textile and fashion industry (TFI) significantly impacts the environment, spurring interest in sustainable practices. Ecolabels have emerged as voluntary self-regulation measures, allowing firms to signal environmental commitment to stakeholders and reduce information asymmetries. However, the industry's complex global value chains and diverse products challenge ecolabel effectiveness. Issues like lack of standardization, inconsistent criteria, and insufficient transparency limit their ability to build trust and guide sustainable choices. This study systematically assesses ecolabels in the TFI to help businesses select suitable labels. An exploratory qualitative approach focuses on ecolabels relevant to the UK market, using academic and gray literature reviews, and data from databases like the Ecolabel Index. We developed a conceptual framework to evaluate and compare ecolabels, addressing information asymmetry and uncertainty. We identified 44 relevant ecolabels, revealing inconsistencies: nearly half do not address climate change, while nine focus exclusively on it. Most ecolabels are non-profit and third-party verified, with only three being ISO Type 1. Findings highlight ecolabels strengths (e.g., lifecycle integration, enhanced transparency) and weaknesses (e.g., fragmented standards, transparency gaps). Ecolabels are crucial for sustainability in the TFI, but challenges remain. We propose a unified definition to reduce confusion and build academic consensus. We recommend standardizing criteria, adopting a system-based lifecycle approach, strengthening standards beyond third-party verification, and improving communication strategies to guide environmentally responsible decisions. Future research should adopt a systems-based approach to ecolabels, considering both social and environmental impacts, and investigate the frequency of their usage and adoption to assess market penetration and effectiveness.

WEDNESDAY ROOM 5.127

SESSION 10

ID: 244 | *Regular Paper*

KEYWORDS: Garment Longevity; Digital Archives; Circular Economy; Digital Fashion; Sustainable practices

Paper Utilising Digital Technology for Garment Longevity

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This research explores methods for repurposing both physical resources and contextual specialist knowledge, offering insights that can inspire and enhance future fashion design and re-manufacturing and archival practices within the industry. It questions whether digital fashion design tools, such as CLO3D can expand from facilitating faster production and consumption to enhancing the use and potential longevity of garments. The study employs an ethnographic approach to practice-based research, where the authors focus on the interaction between the physical and digital worlds, to understand the wider application of CLO3D that promotes the value and lifespan of a garment. Two case studies were investigated to explore the impact of CLO3D on longevity: a historical garment archive that examined historic pattern cutting approaches; a contemporary collection of 30 deadstock sportswear garments. This research aims to enhance the designers understanding and accessibility of archival and sustainable practices by exploring ways to expand the use of a garment through existing digital tools.

ID: 133 | *Regular Paper*

KEYWORDS: Digital Rebound; Sustainable Digitalisation; Sufficiency; Twin Transition

Digital Degrowth – From Rebound to Regeneration

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Digitalisation plays a central role in the transition to more sustainable futures. However, it also has negative impacts, such as rebound effects, significantly undermining digitalisation's efficiency gains. Digital degrowth is a relatively new concept in discourses on sustainable digitalisation. Building forth on the concept of degrowth, first proposed in 1972 and gaining strength in the past 20 years, digital degrowth refers to realigning digital technologies to become regenerative; ecological sound and socially just, while simultaneously contributing to resource efficiency in digitalisation efforts. This exploratory paper reflects on digital degrowth and the rebound effects of digitalisation.

ID: 154 | *Regular Paper*

KEYWORDS: Ecological sustainability; Information and communication technology (ICT); Microelectronics; Trends; Energy efficiency

Navigating Trends and Ecological Sustainability Needs in Germany and Europe's ICT Industry

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Research Fab Microelectronics Germany (FMD), Germany

The Information and Communication Technology (ICT) industry significantly impacts the environment across various life cycle stages, including material sourcing, energy use, and waste. To mitigate these effects, the German Ministry for Education and Research established the Competence Center Green ICT @ FMD, focusing on applied research to reduce the environmental footprint of ICT technologies. This paper identifies five emerging areas within the microelectronics sector that are key for ecological sustainability and the economic future in Germany and Europe to address the negative environmental impact of the rapidly growing demand of ICT: (i) Circularity in microelectronics, (ii) Green data centers, (iii) Green power electronics, (iv) Green quantum technologies, and (v) Green procurement and supply chains. These areas were identified through a systematic approach involving surveys, expert interviews, roadmap analysis, literature review, and market research. Criteria such as geographical relevance, time-related relevance and leverage were used to assess the feasibility of each area. Circularity in microelectronics addresses resource efficiency and product lifetime extension, while green data centers focus on hardware, software, and infrastructure optimization to reduce environmental impact. Green power electronics aims to enhance energy efficiency in critical sectors like electromobility and data centers. Green quantum technologies explore innovative applications in sensors and chemical processes, and green supply chains emphasize reducing CO2 emissions throughout value chains.

ID: 199 | *Extended Abstract*

KEYWORDS: Circular economy; Waste electrical and electronic equipment; Digital technologies; Industry 4.0

Building a Digital Circular Economy for Electrical and Electronic Equipment

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The accelerating pace of digitalisation is reshaping economies and lifestyles, driving unprecedented growth in the consumption of Electrical and Electronic Equipment (EEE). However, this rapid expansion has created Waste Electrical and Electronic Equipment (WEEE) as the fastest-growing waste stream worldwide. The resulting environmental crises underscore the urgent need for a Circular Economy (CE). This paper delves into the critical role digital technologies such as AI, IoT, and Digital Twins can play in enabling a CE for the EEE sector. Through insights from ongoing research projects, a horizon scan and systematic analysis of case studies we analyse strengths, weaknesses, opportunities, and threats to harness the promise of digitalisation while mitigating risks like increased WEEE and energy demands of AI systems. Potential threats, opportunities, and likely future developments related to the development of a digital CE for EEE are presented, including discussion of a range of digital (Industry 4.0) technologies. These findings emphasise potential for these technologies to extend product lifetimes, optimize resource use, and support circular practices but also demonstrate critical challenges that must be addressed to realise these benefits fully. This paper is of value to academics, policymakers, and industry leaders eager to advance the circular economy through state-of-the-art technology.

SESSION 10

ID: 254 | *Extended Abstract*

KEYWORDS: Digital Product Passports; High-Tech Manufacturing; SMEs; Digital Longevity; Circular Economy

Accelerating Circularity in High-Tech Manufacturing: Towards a Roadmap for Implementing Digital Product Passports (DPPs) at SMEs

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The transition to a circular economy presents significant challenges for high-tech manufacturing, particularly among small and medium-sized enterprises (SMEs), which often face resource constraints. Digital Product Passports (DPPs) have emerged as pivotal tools for enhancing transparency, traceability, and lifecycle management in support of circularity. This study, conducted in collaboration with TechValley—a consortium of Dutch high-tech SME suppliers and Original Equipment Manufacturers (OEMs)—explores the barriers and opportunities associated with implementing DPPs. The research employs a multi-phased methodology comprising literature reviews, stakeholder interviews, and collaborative workshops with industry professionals. Participants identified key opportunities for circular design and business strategies, including cost reduction through optimized material use, improved spare parts management, and modular design standardization. Business benefits such as enhanced customer relations, increased revenues from refurbished products, and Product-as-a-Service models were also highlighted. However, several barriers hinder DPP adoption, including high implementation costs, regulatory complexities, and data integration challenges across supply chains. To address these issues, a co-created roadmap was developed, comprising five stages: technology assessment, business model analysis, collaborative workshops, pilot testing, and an innovation agenda for scaling DPP adoption. By leveraging emerging technologies such as AI and digital twinning, the roadmap prioritizes scalability and cost-effectiveness for SMEs. The study contributes to the discourse on digital longevity and circularity by providing actionable strategies for integrating DPPs into SME operations. Future work will involve implementing the roadmap in case studies to evaluate its efficacy in promoting circular value creation and sustainability in high-tech manufacturing.

WEDNESDAY ROOM 4.231

ID: 263 | *Extended Abstract*

KEYWORDS: Circular Economy; Bioeconomy; Textile; Man-Made Cellulosic Fibers (MMCF); Circular Fashion

Regenerated cellulose fibers synthesized with recycled textiles: A circular bioeconomy milestone for material longevity or another fiber overproduction escalation?

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Universidad Santiago de Compostela, Spain

Since 1998, global textile fiber production has doubled, making fashion a significant contributor to environmental degradation. Man-made cellulosic fibers (MMCFs) are emerging as a strategic response within the circular bioeconomy to mitigate these impacts. Derived from biological and regenerative forest resources and its potential to be synthesized from textile waste, MMCFs offer a potential alternative to fossil-based fibers, which dominate global production, and a solution to expand the lifespan of natural textile fibers. In line with this vision, dissolving pulp, the primary feedstock for MMCFs, has seen exponential growth, doubling from 2012 to 2023. While fibers like lyocell are recognized for their sustainability, 80% of MMCFs remain viscose, which shares environmental drawbacks with fossil-based alternatives. Understanding the role of MMCFs into the transition is critical to ensuring their adoption aligns with a circular bioeconomy strategy rather than merely driving further fiber production. This study explores the drivers and barriers of MMCF adoption through econometric ARIMAX modeling, assessing their alignment with a transformative circular economy. Results indicate that although MMCFs improve eco-efficiency, they fail to address systemic issues, including short product and material lifespans and the overproduction of textiles fibers. Rebound effects, linked to unsustainable forest management and fast fashion integration, further jeopardize their ecological potential. Holistic approaches are essential to transform the fashion industry, reducing reliance on unsustainable practices and achieving genuine ecological and economic sustainability. Without systemic changes, MMCFs risk perpetuating existing environmental challenges.

ID: 266 | *Regular Paper*

KEYWORDS: Care-based practices; More-than-human Perspective; Design for Emotional Durability; Wearables; Biodesign

Designing materials with living organisms for care-based practices: an analysis of case studies within the wearables domain

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Design Department, Politecnico di Milano, Milan, Italy

The unsustainable patterns of human consumption, exacerbated by materialism, digital technologies, disruptive global events and the mounting issue of e-waste, demand a fundamental shift in design approaches. In light of these challenges, this paper discusses how integrating living organisms into materials design can facilitate this transition, fostering innovative interactions and enabling care-based practices. By analysing three case studies in interaction design, the research highlights the transformative potential of incorporating biological matter like plants, moulds, bacteria and fungi into domains such as the one of wearables. The biodesign processes examined reveal commonalities, including the unpredictable, transient and time-consuming nature of designing with living organisms, as well as the evolving commitment and sensitivity of both designers and users towards the artefacts. The findings suggest that embracing non-human agency in the design field can nurture empathy and symbiosis and encourage users' ethical practices, responsibility, and emotional awareness. The study provides valuable insights into embedding care in design, redirecting the focus away from the traditional environmental products' durability to a designed temporality, capable of engendering long-term emotional durability.

ID: 267 | *Regular Paper*

KEYWORDS: Industrial waste; Sustainability; Materials characteristics; Product design; Variety

Material discard reasons: Categorising and characterising industrial waste materials

Nikoline Sander, Linda Nhu Laursen

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This paper investigates industrial waste and its characteristics from a design perspective with the objective of assessing why so many materials are discarded. Industrial waste emerges pre-consumer and poses potential as material resources for new product designs on an industrial scale. Most research assesses post-consumer waste, but more than 230 million tons of waste emerge from manufacturing, hence pre-consumer. Current research on industrial waste divides it into scraps and rejects with varying characteristics of predictability and seriality. We add to the research through a two-year research project on designing with industrial waste from Danish manufacturing companies. Through observations, registrations, and semi-structured interviews, we study 24 discarded material cases and assess the challenges for industrial design. From a designer's perspective, we investigate where and why materials are discarded, the categories, and how they can be further characterised. The result is a division of industrial waste into five types: 1) offcuts, 2) rejected materials, 3) rejected objects, 4) process waste, and 5) excess material. They vary in predictability, uniformity, presence of flaws, and data availability. These are characteristics that designers must consider when extending the material lifetime and keeping the material at its integrity level in new product designs.

ID: 274 | *Regular Paper*

KEYWORDS: Upcycling; Scrap; Material; Lifetime; Industrial Design

Upcycling from 'One-of-a-Kind' to Industry Scale: Leveraging Strategies to Prolong the Life of Industrial Waste Materials

Mathias Lund, Linda Nhu Laursen

Aalborg University, Denmark

Industrial production generates discarded materials, most of which are recycled and often downcycled into lower-quality outputs. Reusing materials as by-products or through upcycling offers a sustainable alternative by transforming waste into higher-value products. This study examines how designers upcycle industrial scraps at scale and reframe waste as potential by-products. Through analysis of ten Danish field experiments involving materials such as wood, concrete, leath-er, and fabric, we identify five leveraging strategies that distinguish the design processes of prod-ucts that succeeded in entering the market from those that did not. Drawing on interviews, observations, and archival material, we found recurring strategies: 1) identifying portfolio gaps, 2) leveraging existing production capabilities, 3) adapting processes to integrate by-products, 4) aligning de-signs with brand identity, and 5) reframing material flaws as unique qualities. These findings provide insight into how designers reposition discarded materials within existing industrial frameworks. The study demonstrates how upcycling and the design of by-products, when strategically aligned with company goals, resources, and market position, can extend material lifetimes, reduce waste, and support the transition from one-off prototypes to scalable industrial applications.

SESSION 12

ID: 124 | *Regular Paper*

KEYWORDS: Garment durability; Circularity; Product lifespan; Upcycling; Sustainable fashion

Extending the Lifespan of Garments Globally through Local Upcycling: A Mixed-Methods Approach

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Extending the lifespan of garments is considered a solution to counteract a culture that views them as disposable objects. However, how this is to be done in practice remains unclear. Using a multimethod approach, this study aims to investigate how garments can adapt to their local environment(s) and user(s) so that they can go through different life cycles. To this end, the authors combined data from semi-structured interviews conducted in five different countries and enriched them through triangulation with available literature. We discovered that the durability of garments is dynamic in nature, and that upcycling is a method to extend their lifespans. Furthermore, how the materials of the garment are perceived locally, influences if it is considered eligible for upcycling. As local conditions have not been considered in the definition of the concept so far, we have defined local upcycling as: a process in which materials and garments that are considered worth discarding in their current state are transformed into a product of higher value that is suitable for the local environment, eliminating the need for a new product. Although the lack of field research at the organizational level is a limitation of this study, the authors view this as a potential avenue for future research.

ID: 179 | *Regular Paper*

KEYWORDS: Textiles; Remanufacture; Upscaling; Pre-consumer; Circular Economy

Testing methods of remanufacture of pre-consumer textiles in scalable environments

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Despite a growing response by multiple stakeholders to address waste issues in the industry, the consumer appetite for newness and the speed and agility of the mass manufacturing system encourages overconsumption Currently, less than 1% of the material used to produce clothing is recycled into new clothing. As Walter Stahel notes, wasted material is also wasted money, meaning that increasingly industry stakeholders are looking to exploit the potential economic benefit of 'remanufacture' or 'upcycling'. While many micro-businesses are utilising upcycling on a small scale, the impact on the overall resource wastage is minimal. This paper explores how working in a factory environment can give greater insight into the challenges of working with remanufacture for scale. It will support a greater understanding of the barriers that are impeding the widespread adoption of working with Whole Product (WP) fallout on a production line, while helping to identify the frameworks needed to support methods of WP Remanufacture (WPRem) within the linear commercial environment.

ID: 297 | *Regular Paper*

KEYWORDS: Upcycling; Post-Consumer Waste Clothes; Township Communities; Sustainable Fashion; Community-Based Enterprise

Empowering Township Elderly Women: Upcycling Post-Consumer Waste Clothes into Sustainable Livelihoods

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Cape Peninsula University of Technology, South Africa

Post-consumer clothing waste poses significant environmental and economic challenges, with second-hand garments often discarded despite their potential for reuse. Addressing this issue requires solutions that not only reduce waste but also empower communities, especially marginalized groups like elderly women in township settings. This study aims to explore how upcycling post-consumer waste clothes, guided by cradle-to-cradle principles and co-design processes, can enhance both sustainability and social empowerment among elderly women in a South African township. Adopting a qualitative, case-based approach, participants were engaged through Grandmothers Against Poverty and AIDS (GAPA). Second-hand clothes sourced from local stores served as raw materials. Data collection included semi-structured interviews, participant observations, and examination of final products. Initially, participants relied on intuitive sewing techniques. Later, an expert introduced a structured, step-by-step upcycling method, encouraging them to apply more deliberate design strategies. Before the expert's intervention, participants exhibited resourcefulness and creativity, though without explicit recognition of their efforts as sustainable. After the expert-led workshops, their products showed improved quality, durability, and potential marketability. Participants recognized upcycling as personally enriching, potentially income-generating, and environmentally meaningful. They also expressed interest in sharing knowledge with other grandmothers, indicating a ripple effect of skill dissemination. This research demonstrates that blending community-based ingenuity with structured design guidance can transform second-hand clothing waste into a vehicle for environmental stewardship, social cohesion, and economic resilience. It illustrates how local craftsmanship, informed by sustainable design frameworks, can foster both ecological sustainability and community empowerment.

ID: 284 | *Extended Abstract*

KEYWORDS: Circular Economy; Secondhand Clothing; Sustainable Fashion; Textile Waste Management; Thrift

Hyper-local recirculation of secondhand clothing through donation-thrift networks

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This study investigates the regional diversion networks of secondhand clothing (SHC) thrift retailers in Canada, addressing the rising challenges posed by textile waste in light of increasing clothing consumption and the throwaway culture. With the fashion industry being one of the most resource-intensive sectors, millions of tonnes of textile waste end up in landfills and incinerators each year. The research aims to analyze how local actors, including thrift stores, charitable organizations, and for-profit entities, engage with circular economy principles to manage this waste. By utilizing the territorial circular ecosystem (TCE) framework, this study examines the impacts of geographic proximity and local collaboration on the effectiveness of these diversion networks. Data were gathered through semi-structured interviews with key stakeholders across Alberta, Saskatchewan, Manitoba, and Ontario, complemented by facility tours to observe sorting and resale processes. Preliminary findings reveal a tension between centralized systems and localized networks, indicating that while large-scale systems manage high volumes efficiently, regional networks facilitate better recirculation of SHC. Regional networks emphasize collaboration and community engagement, highlighting the importance of local economic actors and practices in developing circular systems that promote hyper-local recirculation of SHC. Ultimately, the research highlights the significance of localized collaboration in fostering sustainable practices within Canada's SHC diversion landscape, paving the way for more resilient textile waste management systems.

SESSION 13

ID: 283 | *Regular Paper*

KEYWORDS: Garment care; Garment repair; Product longevity, Responsible wardrobe management

The Care and Repair Guide: Reducing Environmental Impact and Addressing Skills Gaps in Responsible Wardrobe Management

Alana James, Nkumbu Mutambo, Suzanne Nicholson, Anne Peirson-Smith, Sophie Wetherell, Abigail Irving-Munro

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This research explores the critical relationship between consumers, brands and the charity retail sector regarding garment care, repair and second-life ownership to encourage responsible wardrobe management. It acknowledges the importance of considered and active garment maintenance practices to ensure the longevity of a garment and retain value to prevent the purchasing of new, replacement garments. A qualitative methodology was informed by an extensive literature review, highlighting the identified problem space and creating a focus on critical gaps in knowledge. The core concepts of care and repair were explored through participatory workshops with charity retail sector volunteers and consumers to gain vital knowledge and skills in sustainable use behaviors. Collaborating with North-East based St. Oswald's Hospice within the charity retail sector, the project empowers stakeholders to facilitate sustainable clothing behaviors intended to extend the lifetime of clothing. Key insights generated include the critical requirements of resource, skills and knowledge, and motivation to ensure holistic engagement with garment maintenance and care. Moreover, these factors need to be underpinned by an individual's attachment of value to a garment, to rationalize the investment of time and effort in care and repair practices.

ID: 301 | *Extended Abstract*

KEYWORDS: Repair-led design; Lived experience; Place-based; Social impact; Creative repair

Repair-focused social enterprises for environmental and social resilience

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Social enterprises have solidified their position as being effective in addressing pressing environmental problems in the past few decades. Repair has emerged as a driving force behind many of them, especially in urban contexts where repair services have been dwindling due to the vast availability of cheap products. In addition to their value as resource maintenance services, they confront societal gaps such as rising unemployment amongst young people in disadvantaged areas (Barraket, Qian & Riseley, 2019). Various examples showcase how, by providing training in repair and reuse, they overcome the barriers of the labour market (Gutberlet, 2016), especially for young people that had some interaction with the legal system (Soppitt, Oswald & Walker, 2021) and at-risk due to early school leaving. In that way, they become the means to pursue environmental and social resilience, in condition of growing precarity. Following this, the paper discusses an example of a newly-established social enterprise with an emphasis on creative repair, situated in Maryborough, a town in regional Queensland. The social enterprise is part of an ongoing initiative titled The Creative Industries, Social Enterprise, Repair and Restoration (CISERR), which has been operating since 2022 by Testimony Arts, a for purpose company, offering creative repair, literacy and numeracy, and life skills workshops to at-risk youth. The initiative has so far been directed toward young men that had some interaction or in danger of a future encounter with the youth justice system. Moreover, it is available as an alternative educational option to young men (15 – 19 years) that have been disengaged from conventional schooling. The impending need of employability pathways for CISERR's youth participants was predominant in the Monitoring, Learning and Evaluation (MEL) findings from the pilot study (2021) and two iterations (2022-2023) of the initiative. For that reason, the third round of the initiative was anchored in creating the circumstances to start a social enterprise in order to support at-risk youth getting prepared for employment or becoming self-employed. (...)

ID: 114 | *Regular Paper*

KEYWORDS: Repair Workshops; Design for Circularity; Sustainability Education; Zero Waste; Design for Sustainability

Mobile Fixer Studio: How to repair one item at a time on campus

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Every year, X University's campus welcomes tens of thousands of students, and the residence halls fill up with belongings. At the end of the year, move-out time witnesses a surge in overfilled dumpsters with many discarded items still in good condition. Despite the concerted efforts of X University's Zero Waste Initiative to mitigate this issue through waste sorting and recycling, the systemic inadequacy of municipal infrastructure poses a formidable barrier. Central to this discourse is the conspicuous schism between items prematurely consigned to the waste stream and those meriting repair and reintegration into the material economy. Consequently, this paper scrutinizes the potential avenues for improvement of this dichotomy. Positioned as an exemplary case study, the collaborative endeavors of an industrial design faculty member and a senior industrial design student embarking on their project at X University elucidate a pioneering intervention: the conceptualization and implementation of a mobile repair station. This innovative apparatus facilitates immersive and pop-up workshops wherein student volunteers are equipped with the requisite skills and resources to refurbish salvageable items. This symbiotic convergence of pedagogy and praxis furnishes a practical solution to the problem of discarded yet reparable goods. It cultivates a culture of conscientious consumption and environmental stewardship amongst the campus community.

ID: 145 | *Extended Abstract*

KEYWORDS: Design for Repair; Sustainable consumer behaviour; IoT; Ai; Immersive Technology

The Value of Emerging Technologies for Enhancing Consumer Trust and Adoption of Repair Electronics

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[1]Delft University of Technology, The Netherlands; [2]Wageningen University & Research, The Netherlands

The premature replacement of electronic products contributes significantly to environmental challenges. Repair presents a promising strategy to extend product lifetime, yet consumer adoption remains low due to barriers such as limited knowledge of fault diagnosis, previous negative repair experiences, and uncertainty in repair efficiency. These barriers raise consumer doubts about the value of repair, reflecting a lack of trust, acceptance, and adopt repair practices. While current "design for repair" studies focus heavily on product architecture, tackling the technical repairability but not addressing consumer repair willingness. A limited number of studies have explored "design for repair" from a consumer perspective, revealing design opportunities to improve consumer confidence in repair. They also indicated the potential of emerging technologies to enhance consumers' willingness to repair. However, a comprehensive overview of the impact of these technologies remains absent. This study investigates existing design solutions to explore the role of emerging technologies—specifically Artificial Intelligence (AI), Immersive Technology, and Internet of Things (IoT)—in facilitating consumers' repair of electronics. Through literature review, this research connects technology capabilities with consumer behaviour study in the context of repair electronics, enriching the "design for repair" theories.

SESSION 14

ID: 174 | *Extended Abstract*

KEYWORDS: ICT; Circular business models; Rental; Refurbishment

Beyond Ownership: The Environmental Impact of Rent, Repair and Refurbishment of ICT devices

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This study investigates the life cycle impact of circular business models (CBMs) across four product groups: smartphones, laptops, game consoles, and cameras. It aims to quantify the potential environmental and economic benefits associated with CBMs by analyzing real activity data from user surveys and actual activity data from companies. Analysis of the current ICT use in Germany, shows that the demand for second hand devices is lower than the supply according to a conducted user survey, while resellers still face difficulties sourcing high-quality devices. The research reveals that circular business models are often interlinked, with various stakeholders involved in the rental and resale markets. Notably, rental companies frequently do not directly provide the services associated with product usage (like repair, refurbishment, data deletion), leading to complexities in evaluating their effectiveness. While renting tends to be less favorable when considering the actual usage time of products, the data indicates that rental services often facilitate second-use opportunities more frequently than traditional sales.

ID: 225 | *Extended Abstract*

KEYWORDS: Small scale electronics; Refurbishment; Repair

Barriers and enablers of extending the lifetime of small scale consumer electronics

Johanna Suikkanen[1], Laura Sokka[1], Tero Heinonen[1], Susanna Horn[1], Jáchym Judl[1], Minna Räikkönen[2]

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There are many sustainability challenges related to smart electronicsFurther to facing pressures from the high and complex material demand, electronics, especially the small complex smart devices, typically have short life cycles and they are usually also difficult to repair. Smartphones tend to be replaced before the end of their technical life and their lifetimes can be even shorter than 2 years. The devices' raw materials thus provide value only for a short period of time. The constant replacement of devices by consumers means a need for more primary and secondary raw materials and thus increase in environmental impacts. Finding ways to extend the lifetime of electronic devices is of high importance and especially reusing these devices as considerable potential for reducing CO2 emissionss and saving (critical) raw materials and energy. This research explores the barriers and enablers of extending the lifetime of smart small-scale electronics with a focus on smartphones. The research considers different aspects of the value chain for extending the lifetime of smart phones. Namely, many significant actors are relevant for enabling lifetime extension including: repairer shops, electronics retailers, extended producer responsibility (EPR) organisations, and companies focusing on refurbishing business models, as well as consumers. The paper presents the results of interviews with these actors and identifies various types of barriers and enablers for extending the life time of smart phones.

ID: 272 | *Regular Paper*

KEYWORDS: Sustainability; Circular economy; Value chain; Circular ecosystems; Collaboration

Collaboration towards the design of sustainable and circular value chains: reviewing the state-of-the-art in literature and practice

Giliam Dokter, Adam Mallalieu, Sophie Isaksson Hallstedt, Ola Isaksson

Chalmers University of Technology, Department of Industrial and Materials Science, Division of Product Development

The transition to a circular economy (CE) is essential for extending product lifespans and maximizing resource use, contributing to resource efficiency and sustainability. Circular solutions demand extensive collaboration across the value chain, encompassing suppliers, distributors, and consumers. Based on a review of literature and existing frameworks for the design of circular value propositions, this study investigates key factors enabling collaboration within circular value chains and evaluates the extent to which existing frameworks address value chain collaboration. Nine key factors for collaborative circular value chains were identified: sustainability leadership, value mapping, shared vision building, trust-building, collaborative governance, collaborative processes, ecosystem perspectives and orchestration, and monitoring and evaluation. The analysis of 38 frameworks showed strong focus on value chain collaboration, but the ecosystem perspective and links to digitalisation and data sharing were underrepresented. The research highlights the role of collaborative governance and ecosystem orchestration in addressing challenges such as stakeholder engagement, data management, and balancing competitive and collaborative interests. Future research should focus on developing tools and frameworks that emphasize the intersection of sustainability, circularity, value chain collaboration, and digitalisation and data management. Comprehensive approaches are needed to help manufacturers develop capabilities for sustainable circular ecosystems, aligning roles and incentives between partners, facilitating collaboration and co-creation, and enhancing data sharing and management. The findings contribute to a deeper understanding of the factors necessary for sustainable collaborative circular value chains, providing a foundation for further research and practical guidance for industry.

ID: 118 | *Regular Paper*

KEYWORDS: Take back; Recovery; Return; Responsible disposal; Circular Economy; Design for X

Exploring take-back recovery strategies in the Circular Economy: A Multiple Case Study Analysis

Yoon Jung Choi, Jiayuan Dong, Jaehoon Pyon

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The take-back of end-of-use products has gained increasing importance with the growing focus on the circular economy. However, not all take-back strategies have been thoroughly explored and understood in relation to consumer engagement. This study examines the role of take-back recovery approaches and strategies in the circular economy, integrating a product design and service lens to address consumer return practices. The research identifies four distinct opportunities under the take-back umbrella: Direct Reuse, Ease of Disassembly, Final Recovery, and Safe Disposal. For each opportunity, potential sub-opportunities are identified and expanded upon. Through a multiple case study analysis, these sub-opportunities are further developed using a "Design for X" approach to form nine distinct take-back strategies. This research emphasizes that the appropriateness of a take-back strategy depends on various factors, such as consumer behavior and context, industry specifics, and material flows. The study highlights the critical role of take-back systems and returns behavior in promoting circular product development and consumption.

Workshop 1: Right to Repair – International Policy Workshop

(Room 3.107)

Leanne Wiseman, Jessika Richter, Anthony Rosborough, Flavie Vonderscher.

The purpose of this workshop is to provide a forum for Right to Repair (R2R) policy and regulatory stakeholders, practitioners and academics to come together to discuss the benefits, challenges and opportunities that the various policy and regulatory approaches that are emerging internationally to remove barriers and provide opportunities to incentivise and support repair. The interest in and support for R2R has taken a number of different regulatory and policy approaches: consumer focussed legislation that addresses barriers to repair in consumer electronics, appliances, cars, wheelchairs, agricultural equipment; copyright reform addressing barriers such as copyright technological protection measures (TPMs) and interoperability; mandatory data sharing laws for automotive repair; tax incentives; repair bonuses and incentives and repair labelling and indexes. Different regulatory and policy approaches that promote and regulate the way in which manufacturers design, produce and label products as well as those that support and elevate community repair initiatives are also part of the broader Right to Repair policy and regulatory landscape.

The goal of this workshop is to both (a) provide a forum for knowledge exchange between international R2R policy and advocacy stakeholders from a wide range of jurisdictions and (b) enable to establishment of international R2R policy and advocacy network.

Workshop 2: Circular Pathways: Bridging Product Longevity and Digitalisation Across Garment Life Cycles

(Room 4.105)

Songyi Yan, Rachel Matthews, Shuchan Luo

The proposed workshop, Circular Pathways: Bridging Product Longevity and Digitalisation Across Garment Life Cycles, aims to address the intersection of digitalisation and circular economy (CE) within the fashion industry. As sustainability becomes an urgent priority for fashion industry, extending product lifetime and reducing textile wastes are critical goals. However, much of the existing research and implementation focus have been concentrated on the design and manufacturing stages of garments, leaving significant gaps in understanding and leveraging digital technologies across usage, maintenance, and end-of-life stages.

This workshop explores how digital tools and technologies can inspire and enhance circular economy (CE) practices throughout the use, maintenance, and end-of-life stages of garments, with a focus on various areas (such as repair, care, restyling, upcycling, recycling, and resale). While much research has examined how digital tools support sustainable garment design and production, Environmental Coalition on Standards (ECOS) estimates that extending a garment's life by merely nine months can reduce its carbon footprint by 20–30%. This statistic underscores the environmental benefits of reusing existing garments and materials, particularly when supported by digital interventions.

In this workshop, participants will engage in discussions about how AI, data analytics, and other digital innovations can support sustainable and circular practices, such as predicting maintenance needs, optimising resale platforms, and facilitating upcycling, recycling, and restyling initiatives. By examining these critical stages, the workshop aims to identify practical opportunities and challenges and co-develop strategies for integrating digitalisation into circular economy systems.

Workshop 3: Possibilities for PPE: How Might we Extend its Use?

(Room 5.125)

Katherine Townsend

The aim of the workshop is to gather ideas and strategies for extending the lifecycle(s) of re-usable PPE isolation gowns, as worn by healthcare workers to treat patients in Intensive Care Units (ICU's). The garment in focus – the Anze.NTU.Revolution-ZERO isolation gown for nurses and surgeons – was developed through AHRC- funded research (2021-2023) that sought to improve their design, wearer experience and sustainability (Šterman et al. 2022).

Currently in the UK these gowns are sent to landfill or offshore to medical charities following 75 washes at 71C. Whilst there is ongoing research to reduce the washing temperature to mitigate damage and extend the first lifecycle, there is also an immediate need to develop 'redesign and remanufacturing' approaches following the return of used garments to reduce the amount of plastic waste and greenhouse gas emissions produced by the PPE/ healthcare industry.

The gown has been designed to be part of a circular manufacturing and reuse system. The circular system is now being piloted alongside a take-back scheme. The system encompasses three additional phases of use: 1) within the healthcare sector; 2) as fashion and textile products; or 3) recycled as polyester yarn, with the goal of avoiding landfill through a 'gown to gown' model (Townsend et al. 2023). Repurposing workshops have been trialled and designers invited to reimagine and refashion the gowns (Townsend and Salter 2023).

Workshop 4: Shaping how we share: Co-creating a community lending library

(Room 5.127)

Lauren Brumley, Corey Ferguson

The age of climate collapse, social individualism, and resource extraction demands alternative modes of material production and consumption to facilitate more use, less waste, and greater social connection (Lynch, 2023). A Library of Things is a model for borrowing instead of buying, sharing instead of owning, and caring for collective instead of individual use for everyday materials (e.g. tools, kitchen equipment, toys, games, electronics, and of course books). But how do Library of Things operate in practice? And how do they best serve the communities they intended for?

This transdisciplinary workshop engages with the practicalities of sharing by designing, building, and governing a Library of Things for the PLATE conference community. Academic research on the practical efforts of renting and returning shared items is still limited. The aim is to engage workshop participants in how we might be able to borrow, share, and care for everyday materials collectively. Bringing together theory and practice (including facilitator experience as a tool library volunteer) workshop participants will build the physical library and its meaning for the PLATE conference, by adding items and creating the rules and responsibilities for renting and returning items. At the conclusion of the workshop, participants will be invited to rent and return an item as they need/want (based on how the workshop participants determine). Participants will gain insight into how people use (and misuse) a shared collection, the effectiveness of rules and reciprocity, and the shifts in materiality that might emerge.

Workshop 5: Exnovation for sufficiency: identifying concepts, relationships and roles for moving towards low-impact consumption

(Room 4.231)

Sara Renström, Anneli Selvefors

The purpose of the workshop is to explore different perspectives on the topics of exnovation and sufficiency. Exnovation addresses the need to phase out unsustainable structures, policies, practices and products (e.g. R Hebinck et al., 2022) and sufficiency addresses how to reduce the total consumption volume and demand for resources while ensuring the well-being of all (e.g. Akenji et al., 2021). Both sufficiency and exnovation seem to be of increasing interest for the PLATE community. Previous PLATE conferences point to an increased number of contributions addressing sufficiency and while exnovation have gained less interest as of yet, exnovation was explicitly covered at the previous PLATE conference for example by Noëth and colleagues (2023). The upcoming conference features specific tracks on sufficiency. Several contributions addressing exnovation and sufficiency can hence be expected this year, along with an increased number of delegates interested in the topics. While both exnovation and sufficiency are gaining interest, there is however still a lack of understanding of if exnovation can pave the way for sufficiency and if so, how. With this workshop we therefore want to invite researchers, practitioners and others to discuss concepts related to exnovation and sufficiency, relationships between concepts and the role of different actors, to increase our mutual understanding of how to facilitate sustainability transitions. On a longer term, insights from the workshop will contribute to improvements of a conceptual framework currently under development that describe how exnovation can contribute to sufficiency-oriented consumption on different system levels.

Workshop 6: 'Blue Is In This Year': A Workshop about Semiology, Sustainable Fashion, and Re-Enchantment

(Room 1.226)

Patricia Kelly Spurles, Meaghan Barnable

Blending semiotic play, psychological reframing, and participatory fashion curation, the proposed workshop engages participants in an activity that challenges fast fashion's dominance over meaning-making in clothing through a game that constructs secondhand fashion as a space of creativity and re-enchantment, rather than compromise or necessity. Participants will be introduced to a card game in which they collaboratively curate outfits and explore the different possibilities of a set number of garments and accessories. Both a thought experiment and a practical intervention, this workshop prompts participants to engage with clothing not as fixed objects of consumption, but as fluid, expressive artifacts open to reinterpretation. This conceptual shift is crucial for changing attitudes toward sustainable fashion, creating opportunities for self- expression without contributing to the environmental burden.

Workshop 7: The Emotional and Physical Durability Duality of Apparel

(Room 1.229)

Eleanor Scott, Mark Taylor, Kate Morris

Garment durability plays a crucial role in the sustainable development of the apparel sector. Extending the lifespan of apparel can potentially increase the use of garments, whilst progressing circular business models such as clothing reuse, rental and other use-oriented product-service systems. In this workshop, participants will explore their personal perception of physical and emotional durability, reflecting on the 'durability duality'; when physical flaws and signs of wear become an emotional durability factor. The workshop will provide an overview of the LITAC Durability Protocol, developed in collaboration with the Waste and Resources Action Programme (WRAP). This includes an explanation of testing methodologies, washing protocols, visual assessments, and classification systems used to evaluate apparel longevity. A hands-on activity will allow participants to assess multiple garment specimens at different stages of test and washing, ranking them based on perceived durability. Workshop facilitators will randomly present the same garment style, but in various states, from new to heavily aged through repeated wash and dry cycles. Participants will be invited to reflect on their own perceptions of clothing durability, by ranking the garments most to least worn, and explaining when items would be deemed no longer feasible for ownership. The LITAC durability protocol data and rankings for these garments will then be presented, fostering discussion on factors influencing durability perceptions and comparing participant rankings with established LITAC Durability Data, identifying key insights and discrepancies between the emotional response and physical data.

DESIGN FOR LONGER LASTING PRODUCTS AND BUILDINGS · ENDURING CONSUMPTION · BUSINESS MODELS FOR LONGEVITY · REPAIR, CARE AND MAINTENANCE · PRODUCT LIFETIME MODELING · POLICIES FOR LONGER LIFETIMES · SUFFICIENCY AND DESIGN FOR LESS · REBOUND EFFECTS AND CRITICAL VIEWS ON PRODUCT DURABILITY · EDUCATION, TOOLS, AND GAMES FOR PRODUCT LIFETIMES · MATERIALS AND LONGEVITY · CLOTHING, FOOTWEAR, AND ACCESSORIES LONGEVITY · DIGITAL LONGEVITY

THURSDAY

SESSION 15

ID: 320 | *Regular Paper*

KEYWORDS: Repair; Survey; Barrier; Motivations

Worthy or not worthy? Repair motivations and barriers from consumers across fashion, furniture, and consumer electronics in Denmark

Andreas Kornmaaler Hansen[1], Linda Nhu Laursen[1], Michael Søgaard Jørgensen[2], Tanja Markussen[2]

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Never has human consumption and demand for products been this high, and the growing demand for products puts a strain on the finite resources available. Therefore, the need for prolonging the lifetime of existing consumer products has received increasing attention from governing bodies such as the European Commission e.g. shown in the 'right-to-repair' directive. While 77% percent of European citizens state they want to repair products before buying new, only 64% state that they have done it – and ~90% have never purchased clothing, smartphones, or televisions secondhand. Prolonging the lifetime of consumer products through repair is therefore an important point towards more sustainable consumption. Yet, a lot of broken products never enter a repair process. This paper aims to shed light on the barriers and motivations for repair to help increase the understanding of how more repairable products can get repaired. Through a Danish national survey (N=1068) and 11 semi-structured interviews, we identify main barriers and motivations for entering a repair process within three main product classifications: Consumer electronics, Fashion, and Furniture. We confirm existing findings that price of repair/replacement is a main motivator/barrier. We also identify perceived repairability and ease of cassation or replacement as barriers not previously described.

ID: 185 | *Extended Abstract*

KEYWORDS: Repair; AI-Powered Repair; Circular economy; Consumer electronics; EEE

AI-powered Consumer Electronics Repair towards a Digital Circular Economy

Nazlı Terzioğlu

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This study investigates the potential of an AI-powered tool, to empower users in repairing consumer electronics, aiming to support a circular economy by reducing electronic waste. Six co-design workshops were conducted with novice and expert participants, focusing on repairing consumer electronics (Fairphone 5 and Fairbuds XL). The tool provided step-by-step chatbot guidance, with participants offering feedback on usability, challenges, and improvements. The results highlight strengths and weaknesses of AI-Fixer, revealing differences in the views of novice and expert users in terms of practicality and usability of the tool. Novice users found AI-Fixer helpful, boosting confidence through step-by-step guidance, though they highlighted the need for more visual aids and simpler instructions. Experts appreciated the concept but critiqued repetitive responses and the lack of dynamic adaptability. Both groups emphasised the importance of multimodal support, such as images and videos, for complex tasks. This study is valuable to academics, product designers, manufacturers, and repair enthusiasts by presenting how AI-driven tools can guide users through repair processes of consumer electronics.

ID: 318 | *Regular Paper*

KEYWORDS: Repair Cafés; Volunteering; Social Practice Theory; Community Repair; Sustainability; Circular economy

Repair Cafés as Circular Economy Enablers: Exploring Participants Practices through Social Practice Theory

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In this paper, we study the repair practices in Danish repair cafés, to understand how repair activities initiated by civil society are organized and sustained within broader social and material contexts. By applying Social Practice Theory (SPT), the analysis dissects the interconnected elements of materials, competencies, and meanings that constitute and shape the ongoing practice of repair in Danish Repair cafés. The repair practices form part of "bundles" of interconnected practices within the repair cafes. The study demonstrates that repair cafés are more than spaces for fixing broken items; they hold broader societal and cultural aspects. Through the interconnectedness of repair, learning, and community-building practices, these cafés challenge the "throwaway culture" and foster a collective commitment to sustainability that potentially could have implications far beyond their immediate settings.

ID: 247 | *Extended Abstract*

KEYWORDS: Garment Repair; Circular Economy; Repair Skills; Community Repair; Socio-Material Practice

Repairing and regenerating the community: a study in activating garment repair initiatives with stakeholders at local level

Anne Peirson-Smith, Sophie V Wetherell, Erica Singer, Alana James, Abigail Irving-Munro, Nkumbu Mutambo, Suzanne Nicolson

Northumbria University, Newcastle upon Tyne, United Kingdom

This paper investigates the function and impact of independent, non-professional, informal repair initiatives (repair hubs) at community level comprising local non-profit organisations and community members or citizens. It explores the role of local garment repair as a regenerative initiative in reducing the environmental impact of fashion consumption by extending clothing lifetimes, facilitating knowledge exchange and upskilling by activating local stakeholder engagement at community level. Using a socio-material practice approach, focussing on how objects and people interact through social behaviours and material actions to create behavioural change, the focus will be on the process and type of knowledge exchange and active learning taking place in participatory repair workshops. The inherent challenges and opportunities in operationalising and scaling up small-scale repair initiatives are also explored. Findings from participants in two repair workshops illustrate how local, community-centered activities can initiate and sustain garment repair initiatives. This occurs by fostering collaborative knowledge exchange, developing material repair skills, and building social networks around sustainable circular practices. Workshop participants, representing a broad demographic range, acknowledged that they learned a transformative range of repair skills extending garment use, enhancing considered garment management, imparting self-sufficiency, while elevating self-confidence, creativity and empowerment in a therapeutic, inclusive, supportive social space

ID: 349 | *Regular Paper*

KEYWORDS: Repair; Service design; Circular economy

A Preliminary Review of Service Design for Repair Practices

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Repair remains an underutilised strategy in the circular economy, often deprioritised in favor of recycling despite its potential to reduce environmental impact and extend product lifespans (Keulemans et al., 2023). This systematic literature review investigates how service design can be leveraged to strengthen repair practices. By analysing 60 studies, three key levels of intervention emerge: (1) the micro level, where service design can influence consumer engagement, producer-user interactions, and repair motivations; (2) the meso level, focusing on tools, digital platforms, and process frameworks that facilitate repair accessibility and efficiency; and (3) the macro level, where service design has the potential to shape regulatory frameworks, business models, and cultural shifts that embed repair as a societal norm. Despite its potential, repair is hindered by challenges, such as product complexity (Owen et al., 2024) and insufficient legislative support (Cole & Gnanapragasam, 2017). This review highlights the role of service design in overcoming these barriers by fostering co-creation, developing repair-focused services, and integrating repair into broader sustainability initiatives (Rubenis, 2023). By positioning repair as a service rather than an afterthought, service design could offer new possibilities for circularity and resource efficiency.

ID: 293 | *Extended Abstract*

KEYWORDS: Clothing; Repair events; Mending; Municipal action; Sustainability

The Importance of Reuse and Repair– A Call for Canadian Municipal Action to Promote Clothing Repair Events

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This study examined how Canadian municipalities support residents in managing unwanted textiles, focusing on clothing repair initiatives. As well as to assess Canadians' awareness and access to community clothing repair events, by focusing on differences between attendees and non-attendees. Firstly, a content analysis of 81 municipal websites revealed that only 17% have official textile diversion or recycling programs, primarily emphasising clothing donation. Notably, only two programs in Vancouver and Toronto included proactive repair efforts. Furthermore, an online survey assessed Canadians' awareness and participation in clothing repair events. A total of 582 valid responses were collected. Among respondents, 107 had attended clothing repair events, while 475 had not. Despite a low response rate for previous clothing repair event attendance, both participant groups displayed a relative ability to attend clothing repair events. However, 50.1% of non-attendees were not aware these types of repair events occurred. The findings underscore a critical gap in municipal support for textile repair initiatives, highlighting the need for increased public awareness and community engagement to promote sustainable practices.

THURSDAY

ROOM 3.107

ID: 127 | *Extended Abstract*
KEYWORDS: Wooden material; Product-service systems; Innovation; Buildings; Circular economy

Product-service Systems for Regenerative and Long-lasting Buildings: Case of Wood in Finland

Anne Maria Katriina Viljanen, Angelina Korsunova-Tsaruk, Sofia Oijala, Anne Toppinen
University of Helsinki, Finland

New market demands on building solutions both mitigating and adopting to both climate change and biodiversity are on the rise. Wood material has been considered to be renewable, low carbon and regenerative material for buildings. As a response to expected market growth there are many bundles of innovations brought forth by the companies and their collaborative partners in the realm of sustainable buildings and connected to wood material in a spectrum of ways. In our study we focus on mapping the range of innovations designed to make buildings and embedded materials longer lasting, encompassing new products, services, and most importantly enhancing product-service systems in Finland. By applying insights from 20 qualitative interviews and literature on product-service systems (PSS), sustainable innovation and different typologies of servitized, circular, and regenerative business models, we are able to shed light on new sustainable innovations developed by forefront companies and connected to the use of wood material. We elaborate on wooden construction and retrofit innovations with a focus on adaptive, flexible and extending building with longevity (Pelsmakers and Warwick 2022; Kuittinen, 2023). The main functionalities of these innovations centered around resource efficiency but could be bundled more tightly together to achieve greater sustainability impact to favor circular economy and resilience to environmental challenges.

ID: 129 | *Regular Paper*
KEYWORDS: Reuse in healthcare; Circular economy; Waste reduction; Surgical instrument sets; Design of reuse context; Willingness to reuse

Redesigning single use to reuse: identifying opportunities for surgical instrument sets

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Hospitals have a significant impact on the environment due to their size, energy-intensive processes, consumption of resources and waste generation. A trend of increased reusable products usage and so re-sterilized products is becoming visible. Nevertheless, reusable products have to compete with the added values of single use regarding convenience, effort and costs. Although the concept of reusable sterile surgical instrument sets seems valuable to reduce resource consumption compared to single-use instruments, their use is threatened by multiple inefficiencies. This case study aims to understand why the sterile sets usage is not optimal, what the consequences are for the various departments, what journey they take within the hospital, and how communication occurs regarding these sets. Observations and in-depth interviews were conducted in operation rooms, central sterilization department and the healthcare logistics department of a large sized university hospital. This led to a roadmap of the sterile surgical instrument sets within the hospital through each department involved. Using the roadmap, several critical points are discussed to design optimal reuse contexts in hospitals. In sum, we found that sets are often incomplete due to (i) a lack of turn over time for checking completeness, (ii) difficulty of recognizing specific instruments based on their name, (iii) lack of a good communication system to communicate incompleteness. Additional unwanted waste is created due to (iv) extra sets that are opened as a precaution for missing instruments, (v) unused instruments are thrown away or re-sterilized, (vi) broken sterility due to storage problems, which requires repackaging and re-sterilization.

ID: 138 | *Regular Paper*

KEYWORDS: Sustainability; Ecodesign; Yacht design; Life Cycle Design; MPDS

Evaluating Ecodesign Methodology in Yacht Design: A Professional Workshop Case Study

Ludovico Ruggiero, Massimo Piccioni, Andrea Ratti

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The yachting industry faces increasing pressure to adopt sustainable practices driven by regulatory requirements and evolving consumer expectations. This study explores the application of Life Cycle Design (LCD), also referred to as Ecodesign, methodologies within yacht design to address environmental challenges. Despite the critical importance of early-stage design in determining a product's environmental impact, the yacht sector lacks industry-specific sustainability guidelines. This research investigated the practical implementation of the MPDS (Method for Product Design for Environmental Sustainability) through an intensive workshop involving young professional yacht designers. Participants were tasked with developing concept designs for a 50-ft charter yacht, applying six LCD strategies: use extension, material consumption reduction, energy consumption reduction, material life extension, toxicity reduction, and resources conservation. The study outlined both opportunities and limitations in applying MPDS to yacht design. While participants achieved incremental improvements in certain strategies, the research highlighted the need for context-specific adaptations. Challenges included the methodology's generic nature and the complexity of yacht design processes. The findings underscore the potential of LCD principles in promoting sustainability within the nautical industry and provide a foundation for developing tailored guidelines that can effectively integrate environmental considerations into yacht design processes.

ID: 155 | *Extended Abstract*

KEYWORDS: Design; Reusable Packaging; User Experience; Circular Economy; Sustainability

Reusable Packaging Systems: Design Recommendations for fostering and sustaining consumer adoption

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Reusable packaging systems (RPS) depend on consumer uptake and retention for environmental and economic viability. Identifying areas of improvement for current reuse systems is necessary to refine and develop future systems for prolonged interaction. This extended abstract presents the initial findings from a consumer survey (n=375). Participants are provided 52 statements relating to the packaging and system's design. A descriptive and statistical analysis of the dataset is conducted. Findings highlight 4 overarching factors to consider when designing effective reuse systems. Relationships between consumer demographics (i.e age, gender, salary, location) and consumer attitudes/ behaviours towards RPS is also explored.

ID: 178 | *Extended Abstract*

KEYWORDS: Circular economy; Business ecosystem, Reused wood; Wood construction; Circular solution

Circular bioeconomy business ecosystem in Finland: from barriers to solutions for wood material reuse in construction

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Changing to circular patterns of sustainable production and consumption requires reconsidering how value is created and captured, and what new roles in business ecosystems can be identified. Previous research found wood has the greatest reuse capacity when compared to conventional materials. Although the EU is emphasizing circularity of wood from construction, the current rate in Finland is at a marginal level. Research has shown that further enhancement of business ecosystem is critical for the increase of wood material circularity. This study explores the business ecosystem actor's involvement in wood circulation in Finland and analyses the rationale behind the barriers to increasing recycled wood materials used in construction. Data is based on 14 semi-structured qualitative interviews and two workshops with experts from different wood construction life phases. Our study found the business ecosystem is complex and the strong links between construction operational level actors focusing on reused material market are yet largely missing. Our thematic analysis found the strong positions of the forest industry and virgin wood products in Finland may serve to weaken the uptake of used wood from construction. These market barriers are linked with the cultural ones, such as perceived high risks to new practices, and wariness towards innovation and resulting lack of collaboration throughout the entire ecosystem. Study findings also emphasize the significant role of mediating actors, like material hubs management, in accelerating the circularity of wood. From workshops, we gathered several practical solutions, including the use of digital platforms for better circulating wooden building materials.

ID: 182 | *Regular Paper*

KEYWORDS: Adaptive reuse; Retail and hospitality design; Local tourism; Place-based potential

From Empty Shops to Vibrant Communities: Adaptive Reuse as a Sustainable Response to Retail Decline

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Rapid and significant reductions in global carbon emissions are needed to remain within Earth's limits. The construction and operation of buildings account for the largest share of the global consumption of raw materials, and they yield around 40% of global carbon emissions. Leading climate researchers therefore recommend adapting housing needs to existing building stock instead of constructing new buildings. This requires shifting the focus from what we desire to how we can adapt our needs to existing spaces. This paper, a work in progress, examines the misalignment between sustainability ambitions and tourism strategy in a Danish municipality. This municipality has yet to fully integrate the potential of its existing building stock into its tourism plans. This oversight is striking, given the municipality's ambitious goal of achieving CO_2 neutrality and availability of surplus building stock, including vacant retail spaces in shopping streets. Building on this observation, we propose a conceptual framework for incorporating existing buildings into the municipality's tourism strategies. Rather than expanding their climate footprint by constructing new accommodations for tourists, we suggest a solution centered on using vacant spaces and renovating existing structures. Specifically, we envision repurposing vacant retail spaces into holiday apartments, boutique hotels, or other types of housing. This paper lays a foundation for further research to increase awareness of this issue and to test and refine our proposal. The overarching goals are to support sustainable urban development, promote climate-friendly behavior, and strengthen local community and economic vitality in small and medium-sized towns through longer-lasting buildings.

ID: 193 | *Regular Paper*

KEYWORDS: Fashion; Textiles; Australia and Queensland; Gender; Policy

Gendered threads: Policy barriers to sustainable textiles lifecycles

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Queensland University of Technology, Australia

This research into global and Australian policy in textile circularity focusses on Queensland as a case study. Queensland is still lacking a comprehensive roadmap to textile circularity and does not have a strategy for used clothing collection. These activities are left to charities, which benefit from tax breaks, and industry, which is heavily subsidised with public money, ignoring the reality of an industry that is made of micro and small businesses and is predominantly female. Policies that are not scrutinised through a gender lens could continue to create gender disparities, inequalities and systemic barriers, leaving behind women who want to enter the formal repair economy.

ID: 111 | *Regular Paper*

KEYWORDS: Circular Economy; Policies for extended lifetimes; Product obsolescence; Mandatory design standards; Problematisation analysis

What's the Problem with Product Obsolescence? Critical Policy Perspectives from Australia's Right to Repair Inquiry

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Extending product lifetimes is a critical aspect of achieving Circular Economy outcomes, however current policy discussions in Australia do not adequately address product obsolescence (PO). Using a problematisation analysis method, this research aims to uncover how PO is framed within Australia's Right to Repair (R2R) Inquiry and how these problematisations impact the effective transition to a Circular Economy. The document analysis results indicate that Australian regulatory interventions shift responsibility for PO onto consumers, framing the issue as one of consumer choice driving rapid disposal. It was found that despite strong support for design stage interventions in submissions to the Inquiry, the report ultimately recommended against placing PO obligations on producers. Instead, the report suggested introducing labelling requirements, placing the burden of obsolescence on consumers. This framing reflects an ideology of economic rationalism, driven by governmental hesitancy to strongly regulate the private sector. In this representation, the environmental impacts of PO, and the importance of regulation in environmental conservation, are minimised. The Australian approach can be contrasted with the European Union approach which places responsibility on producers to design products in accordance with eco-design requirements and disseminate repairability information, emphasising the role of comprehensive policy mixes in driving positive environmental outcomes. The contrasts between these solutions reflect different understandings of not only what the problem with PO is, but also who is responsible for it. This research posits that without a reconceptualisation of the problem representation of PO in Australia, Circular Economy outcomes will not be achieved.

ID: 147 | *Regular Paper*

KEYWORDS: Regulations; Legal Framework; Eco-Design; Extended Producer Responsibility; Fashion

How Policies are Shaping Longer-Lasting Textiles in Europe

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Several European countries have identified post-consumer textile waste as a pressing concern and are now driving the industry toward circular practices through regulatory measures. These policies target waste reduction at all stages of the product lifecycle, emphasizing product life extension strategies such as reuse, repair, and resale. Additionally, durable, and repairable product designs are essential for fostering longer textile lifespans. This paper provides an overview of EU-level and individual member states' policies promoting textile life extension, focusing on their scope, targeted lifecycle stages, and implementation progress. Findings reveal that while these policies address all lifecycle stages, most national-level initiatives focus primarily on end-of-life management. Few policies emphasize the use-phase or the alignment of national and regional frameworks, which is critical for achieving circularity. A comparative analysis highlights that only a few countries, including France, the Netherlands, and Latvia, have adopted high-intensity legal frameworks with specific, enforceable targets. Many nations rely on strategies and incentive-based approaches with low to moderate targets, limiting their impact. Challenges include navigating complex certification and compliance systems, insufficient industry capacity for product redesign, and inadequate consumer awareness. Additionally, disparities in economic and logistical capabilities across member states pose barriers to uniform implementation. The paper argues that simplifying regulatory frameworks, enhancing transparency, and providing economic incentives are vital to overcoming these challenges. Coupled with robust infrastructure investments and collaborative efforts, these measures can accelerate the EU textile industry's transition to a circular economy.

ID: 200 | *Regular Paper*

KEYWORDS: Product lifetimes; Policy; Planned obsolescence; Repairability; Durability

National leadership for legislating longer product lifetimes: French policies and their interaction with European Union policies

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Currently, the European Union (EU) is the “green leader”, globally, in adopting policies to support longer product lifetimes. One reason for this state of affairs is that EU Member States are adopting progressive policies, which put pressure on the EU to set EU-wide laws to replace national ones. The main reason for this situation is that national rules may lead to distortions in trade in the EU Single Market, as corporations will find it difficult to be able to comply with different national rules and would prefer EU-wide standards. Currently, France is the undisputed leader in adopting policies for longer lifetimes, through policies including criminalization of planned obsolescence, modulated fees, repair policies, banning destruction of unsold products, and national indexes for repairability and durability of products. When the EU adopts similar policies, this can have several positive implications, but there can also be negative effects, for instance that the EU rules are less progressive than the national ones. The aim of this paper is to discuss the key benefits and drawbacks with EU harmonization of national rules, using France as an example. This paper maps the key French policies supporting longer product lifetimes and the upcoming EU rules aiming for EU-wide harmonization. Finally, we describe one policy where EU rules are likely to be less progressive than the French ones, mandatory repair information to consumers, to exemplify key trade-offs with harmonization.

ID: 208 | *Regular Paper*

KEYWORDS: Design for Traceability (DfT); Circular Economy; Digital Technologies; Sustainability; Lifecycle Management

How to enhance Transparency and Accountability by designing products and materials with features that allow their entire lifecycle to be tracked and documented in the manufacturing sector?

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Design for Traceability (DfT) is a progressive approach focused on integrating transparency and accountability into product lifecycle management. Grounded in circular economy principles, DfT employs digital technologies—such as blockchain, RFID, and Material Passports—to monitor materials and products from raw material sourcing to reuse or disposal. This approach addresses global challenges like resource scarcity, ethical sourcing, and waste management while promoting circular business models and sustainable practices. This research investigates how advanced technologies enhance DfT's effectiveness in fostering sustainability within the manufacturing sector. It explores strategies like lifecycle design, modularity, and product-as-a-service models, emphasizing the importance of designing for disassembly, recycling, and remanufacturing. Key methodologies include literature reviews, case studies, surveys, and pilot testing, leading to the development of a comprehensive framework for implementing DfT. The findings aim to identify essential digital enablers, such as distributed ledger technologies and digital threading, and assess their impact on improving resource efficiency, reducing waste, and enhancing traceability. Challenges such as data integration, stakeholder collaboration, and economic viability are addressed, offering actionable insights for manufacturers. DfT's potential is illustrated through case studies across industries like electronics, construction, and fashion, highlighting its role in driving sustainability, regulatory compliance, and circularity. By embedding traceability into design and operations, DfT enables a transformative shift toward a transparent and circular global economy.

THURSDAY

ROOM 5.125

ID: 137 | *Extended Abstract*
KEYWORDS: Minerals; Materiality; Time; Linear time; Time-circles

Minerals as Keepers of Time

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Society is increasingly depending on advanced technology. Especially during the last decade, our understanding of the Anthropocene, the proposed geological time in which human activity has a significant impact on the planet's climate and ecosystems, has expanded to include the minerals needed for the production of digital devices, the storage of date, and computing infrastructures. The increasing development, testing, and use of artificial intelligence (AI) has accelerated mineral consumption. There is tension between the needs of the new wave of AI and the proponents of digital degrowth, who propose reducing technology consumption because, among others, of the unsustainable impact of mineral mining. For instance, as one of the first countries in the world, Norway has approved the deep-sea mining of minerals needed for the so-called twin transition, the digital and energy transitions. Deep sea mining will result in significant harm to marine life. How do we create awareness of the unsustainable mining of minerals? This paper proposes a focus on time to cast light on the effects of human overconsumption. Minerals cannot disappear; they may take other forms and value, but they will always remind humans of how they have (mis-)used them over time.

ID: 150 | *Regular Paper*
KEYWORDS: Dysprosium; Rare earths; Demand; Climate targets; Circular economy

Can Circular Economy Strategies Limit the Prospective Dysprosium Demand in the European Union?

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Dysprosium (Dy) is a high critical rare earth element, which is basically used for improving the thermo-magnetic properties in various low carbon products. This research provides a detailed examination on the evolution of Dy demand, in-use stock, and end-of-life (EoL) under ambitious climate targets and demand shrinkages that can be expected due to the implementation of two circular economy strategies: material efficiency and end-of-life recycling in 13 product sectors in the European Union from 2022 to 2050. Our results indicate that future Dy demand, in-use stock accumulation, and EoL generation are likely to be exacerbated by High-APS (Announced Pledges Scenario) and High-NZE (Net Zero Emissions by 2050 Scenario). Moreover, the circular economy strategies used in this study will contribute to significant decreases in the future Dy demand when such strategies are combined and applied in a high magnitude under High-APS and High-NZE scenarios. Recent efforts in the partial and full elimination of Dy mainly in high-tech products such as wind turbines and electrical vehicles are admirable, however, it is necessary to more focus on improving the implementation of circular economy strategies in manufacturing processes to mitigate future Dy supply uncertainties in the European Union.

ID: 168 | *Extended Abstract*

KEYWORDS: Time; Expressive characteristics; Evolutive textile; Database as tool; Textile product lifespan

Lightfastness Natural Color Database: A tool for designing evolving effects on textile surface through sunlight exposure

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In the western textile industry, the core principles of aesthetic and technical object quality are largely tied to the unchanging nature of the product surface over time. Material change, like sun-faded furnishing textiles, is commonly perceived as damage or degradation. Known as 'cosmetic obsolescence', this phenomenon contributes to premature disposal and unsustainably short product lifespans (Lilley & al., 2016). However, research demonstrates that a carefully orchestrated change on the surface of a material has the potential to be leveraged to increase the lifespan of products by creating and maintaining physical and emotional durability (Chapman, 2005), as well as to globally reduce the environmental impact of a product (Kumar & al., 2023). From this perspective, through a design research approach, this article examines how taking into account the reactions of natural dyes to long-term exposure to natural light upstream in the design of textile products can propose a new definition of color resistance and open a new path for design with biocolours. In this idea, the research has realized a lightfastness natural color database created as a tool for textile designers. This "chromo-chronological" colour chart and creative method is made for designing textiles capable of negotiating our perception of wear and tear by making patterns appear or disappear over the time of use.

ID: 176 | *Regular Paper*

KEYWORDS: Material Experience; Sustainable Materials; Circular Economy; User Emotive Response

Sense of Order: The Effects of Machine Aesthetic on Biomaterials Favourability

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Designers are increasingly creating materials from renewable and recycled sources to support a circular economy, aiming to mitigate the adverse effects of linear production and consumption. These materials are positioned as sustainable alternatives to fossil fuel-based plastics. While users may be drawn to the sustainability narrative and "biography" of such materials, the highly natural appearance of biomaterials can sometimes evoke less favourable responses. This study examines how "machine aesthetics"—visible signs of production like graphic embossment and engraving—impact user perceptions of biomaterials. The research explores how surface alterations influence emotional responses and underlying appraisals by comparing reactions to biomaterial samples with a high degree of naturalness against those with embossed and engraved surfaces. Findings reveal that machine aesthetics evoke a sense of order, enhancing user perception by reducing concerns about material performance. Although users value biomaterials for their natural origins, structured human-imposed aesthetics satisfy a desire for order and aesthetic control. This finding suggests that people appreciate sustainable materials' natural imperfections when presented within a framework of manageability and familiarity.

ID: 181 | *Regular Paper*
KEYWORDS: Textile design; Fiber materials; Longevity; Sustainability; Circular Economy

Design-ability in the Circular Economy of Textiles

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Recent research underscores the importance of longevity, defined as the combination of high and long-term usage frequency and durability, in the textile and fashion industry's shift toward circularity and sustainability. This paper explores and discusses the designer's ability to design for longevity of textiles. Thus, focus is on the potential role of textile designers, examining the extent to which the skills and competencies of the designer may potentially have an actual influence on longevity. Additionally, the paper discusses the systemic context that creates opportunities for design to contribute to the longevity of textiles and garments. Theoretically, the paper draws on Young's framework of levels of context—specifically design in context and designing context—as well as Pineda et al.'s emphasis on the relationship between contexts and the designed object. Empirically, the study is based on data collected from an ongoing research project, [Project X], in which a consortium of academic institutions and industry partners explores opportunities for textile recovery through material-led experiments with recycled textile fibres, further processed in a local R&D factory setup. This paper demonstrates that the challenges of recycling extend beyond design strategies and material experiments, encompassing cultural perceptions and the opportunities available to designers. Furthermore, by highlighting the competencies required to facilitate relationships and collective knowledge building through textile prototypes, the paper supports previous research suggesting that designers play a central role in the transition toward sustainability.

ID: 246 | *Extended Abstract*
KEYWORDS: School uniforms; Circular economy; Textile waste; Sustainability; Second-hand clothing; Parental behaviour; Victoria; Australia

Exploring Parental Engagement in Sustainable Practices for School Uniforms: A Circular Economy Perspective

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The transition to a circular economy (CE) offers transformative solutions for mitigating the environmental, economic, and social challenges posed by the traditional linear 'take-make-dispose' model. This study investigates the integration of CE principles within the school uniform sector, focusing on parental behaviour, drivers, and barriers in purchasing school uniforms. Adopting a mixed-methodological approach, which incorporated material flow analysis and surveys, data was gathered from 102 parents, as well as a focus group comprising six parents of school-going children in Victoria, Australia. The findings highlight key aspects such as cost and accessibility, environmental awareness, and quality concerns. Affordability emerged as a significant factor, with many parents opting for second-hand uniforms to save costs. Environmental awareness also influenced parental choices, though quality concerns regarding second-hand items were noted. The study emphasises the importance of durable, breathable, and washable fabrics, and the need for greater transparency in uniform production. Community engagement through initiatives such as uniform swaps and educational campaigns can normalise sustainable behaviours and reduce social stigma. The study concludes with actionable recommendations for schools to enhance sustainability and reduce textile waste, advocating for the integration of digital tools and community-driven approaches to support sustainable practices in school uniforms.

THURSDAY **ROOM 5.127**

ID: 265 | *Extended Abstract*
KEYWORDS: Sustainable consumption; Cost of ownership; Product lifetimes; Economic benefits; Repair

The Hidden Cost of Cheap: Are We Paying More for Short-Lived Goods?

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The relationship between product pricing and long-term consumer expenditures remains poorly understood. This study represents the first empirical investigation into this link for consumer products, specifically electronics. It evaluates whether higher-priced items, often associated with durability and repairability, lead to lower total ownership costs or if cheaper alternatives impose higher long-term economic and environmental burdens. Using the Total Cost of Ownership (TCO) framework, this study quantifies the annual ownership cost of products based on purchase price, service lifespan, repair probabilities, and repair costs. Recent empirical data on product lifespans and repair patterns are integrated with complementary consumer surveys and Action retailer data in the Netherlands. These data inputs allow for calculating TCO and identifying optimal price thresholds, demonstrating that the cheapest option does not necessarily result in lower lifetime costs. The results show significant variability across product categories. While repairability scores such as iFixit and FRI highlight ease of repair, they fail to directly translate into cost savings or replacement rates. This study bridges that gap by ranking products based on TCO and mapping the economic and sustainable implications of their replacement rates. Ultimately, this research identifies price ranges that minimize both financial and environmental costs for various product categories. It offers actionable insights for consumers, retailers, and policymakers, emphasizing that sustainable consumption strategies can align with economic efficiency when informed by data-driven approaches.

ID: 281 | *Regular Paper*
KEYWORDS: Material relations; Materiality; Everyday life studies; Stuff; Sustainable consumption

Guilty (or invisible) materiality in everyday object relations?

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“Stuff is ubiquitous and problematic . But whatever our environmental fears or concerns over materialism, we will not be helped by either a theory of stuff, or an attitude to stuff, that simply tries to oppose ourselves to it…” Nevertheless, previous research suggests that there are indeed a number of factors in our daily relationships with stuff that may act as obstacles to changing behaviour. Termed “guilty materiality”, the themes explored form a basis for looking at why materiality and material relations may be stigmatised, invisibilised, ignored and avoided. In today’s context, demanding radical change, even on the scale of our daily behaviour, this article aims to build on research into “guilty materiality” to better understand obstacles to changing our everyday material relations. Daily material relations self-documented by 82 university-level design students provide the tangible basis for exploring and highlighting obstacles and ambiguities in daily-life artefact relations and their materiality. Our study focuses only to what is touched by the cohort, constituting a limited number of artefact encounters. The main analysed material is individual maps produced by students visualising their daily consumption habits. While the long-term aim of this research is to help identifying leverage points and action areas related to current practices and also mindsets, this paper also presents and explores the pertinence of the proposed methodology in this context. This research discusses, refines and adds to an existing list of triggers/influencing mechanisms that may act as obstacles to more environmentally-relevant everyday material relations.

ID: 317 | *Regular Paper*

KEYWORDS: Consumption Practices; Values; Ethical Beliefs; Second-hand Market; Consumers

The Consumption Economy – Finding Value in Our Clothing

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The fashion industry is one of the largest global polluters, with its linear 'take-make-dispose' supply chain model driving unsustainable consumption patterns. With over 100 billion garments produced annually, the industry contributes significantly through over-production and consumption in the multi-billion dollar industry. Overarching Question: This study investigates consumer consumption practices to understand the true ethical beliefs and values of individuals in relation to fashion purchasing, use, and disposal. Consumption practices are rarely explored by understanding consumer deeper thoughts and perceptions in second-hand retail, despite garments having an average lifespan of 3.3 years, many clothing items are unused, with 26% of garments in the UK remaining unworn (SCAP, 2021).Sub Question: The effects of the high and low value of clothing in the second-hand economy need to be investigated with the collection of empirical data of consumption practices. Predominantly unseen activity in Consumer-to-Consumer (C2C) transactions remains underexplored, executed through digital and online selling platforms. Sub Questions: This study examines consumer's ethical belief systems that influence second-hand purchasing behaviour. Exploring participants' motivations when engaging in second-hand markets in physical and online spaces, it highlights the complexities of consumer belief systems that shape their purchasing behaviour. The findings emphasise the importance of values and beliefs playing an integral role in the second-hand market landscape—challenging traditional consumption models and shedding light on potential avenues for innovation in a circular fashion future.

ID: 324 | *Regular Paper*

KEYWORDS: Urban Upcycling; Circular Design; Sustainability; Furniture; Aesthetics; Consumer Perception

Selling repurposed furniture: An exploratory study into consumer perception

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Repurpose is becoming more popular as a circularity strategy. This circularity strategy is specifically promising in the case of furniture (Sung, 2017). One of the challenges of upscaling repurpose is the negative consumer perception of repurposed products (Singh et al., 2019). Repurposed product can benefit from storytelling about the past identity of the product (Kamleitner et al., 2019). Further studies up to date pertain to consumer perception of refurbished products and products using recycled content. In this study we investigate (1) to which extent the motives mentioned within literature play a role when it comes to consumers 'perception of repurposed furniture and (2) to what extent the visibility of past identity of repurposed furniture and storytelling play a role in consumer perception. The result indicate that aesthetic and functional quality are highly valued. Storytelling seems to be a secondary motive for customers to consider a repurposed product. We further identified three categories or repurposed furniture (i.e., visibly repurposed, non-visibly repurposed and unique look) that appeal to different consumer segments. While further research can be done into the demographic profiles, these categories can be used by designers/makers to make repurposed product that better appeal to their envisioned customer base.

ID: 149 | *Regular Paper*

KEYWORDS: Design for Sustainability; Toy Consumption; Emotional Durability; Product Longevity; Generative Design Research

Exploring Emotional Attachments in Children's Toy Relationships: A Generative Co-Design Approach to Design for Sustainability

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The existing production and consumption system is causing significant plastic waste in the toy market. Unfortunately, most toys are discarded within six months of purchase, often due to the limited opportunities for extending the lifespan of toys through repairing, reusing, or recycling. To address this issue, this study explores the potential of emotional durability as a strategy to promote sustainable consumption in the toy industry. Utilizing the Emotional Durability Design Nine Framework as a theoretical foundation, this study emphasizes creating long-lasting emotional connections between children and their toys through various dimensions such as narratives, identity, relationships, and evolvability. A mixed-method approach is employed to engage children aged 10 to 12 in reflecting on their emotional attachments to toys, starting with semi-structured interviews with five children to identify their favorite toys, which they have kept for an extended period, and the factors influencing their attachment. Following that, an activity set is designed to explore the stories associated with these toys and tested with four children. Finally, the refined version of the activity set is conducted in the classroom with 30 children. Findings indicate that personal memories, the desire for personalization, and the ability to repair or modify toys significantly influence children's attachment and the longevity of their toys. By integrating emotional durability into toy design, the study highlights its potential to encourage sustainable consumption practices and reduce waste in the toy industry, which may also encourage children to see toys as valuable, long-term companions rather than disposable items.

THURSDAY ROOM 3.107

ID: 220 | *Regular Paper*

KEYWORDS: Premature obsolescence; Long product lifetime; Eco-design for Sustainable Product Regulation (ESPR)

Does the EU Eco-design for Sustainable Product Regulation Address Premature Obsolescence? A Systemic Perspective on Barriers to Longer Product Lifetime

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Premature obsolescence has significant environmental and socioeconomic impacts. Extending the lifetime of products is a key aim of the Eco-design for Sustainable Product Regulation (ESPR), recently introduced by the European Commission. Several barriers to achieving longer product lifetime have been identified in the literature. By examining the systemic interplay among these barriers and forms of premature obsolescence, we develop a framework to analyse the potential effectiveness of ESPR. Our findings reveal that these barriers are interconnected and mutually reinforcing, confirming the need for public policies that address these interactions and reduce premature obsolescence. Moreover, while the ESPR successfully addresses technical and economic challenges related to product lifetime extension, it remains limited in tackling symbolic obsolescence and ingrained societal consumption patterns.

ID: 227 | *Regular Paper*

KEYWORDS: Sufficiency; Policy; Electronics; Production; Consumption

Sufficiency in European Product Policies: Status Quo and Future Potentials

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Technological innovations and efficiency measures have been the primary focus of many policies aimed at meeting global sustainability and resource security goals. However, it has been established in literature that these measures alone are unlikely to drive long-term sustainability or reduce absolute resource demands. Sufficiency-oriented approaches, which focus on slowing down and minimising resource use, are often overlooked in current policy frameworks and business strategies, especially in resource-intensive sectors like the electronics industry. Given the pressing need to address resource overconsumption and its environmental impacts, it is essential to explore how sufficiency can be incorporated into product policies. This paper analyses the current state of sufficiency-oriented measures in European product policies, taking consumer electronics and electrical devices as a case study, and proposes supplementary instruments that can advance sustainability targets. We also develop a categorization framework for sufficiency policies to lay the groundwork for future empirical research, which can help guide policy developments and encourage broader adoption of sufficiency strategies.

ID: 312 | *Regular Paper*

KEYWORDS: Consumer behavior; Disposal; Service life; Electrical and electronic equipment (EEE); Institutional economics

Getting rid of electrical and electronic equipment. Disposal decision and service life in the light of institutional economics

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Within the product life cycle, the user's decision regarding disposal (i.e. getting rid of the product) at the end of the utilization phase plays an important role in terms of the service life of a device of electrical and electronic equipment (EEE). This article first examines from an economic perspective whether and how consumers dispose of EEE. The costs of ownership, the utility of ownership, and disposal costs are identified as the key determinants for this decision. It is the costs of ownership that is the actual cause of the will to dispose, and it is the latter two determinants that prevent the user from disposing of them. While the size of the utility of ownership is already frequently analyzed in the discourse on repair, the perspective of disposal costs seems to receive little attention. Therefore, the article continues to investigate the extent to which the determinant of disposal costs can be put to use for regulation towards a circular economy. To this end, three disposal paths (circular, official-final, illegal), the regulatory objectives associated with them (prevention, safe disposal) and the types of hurdles associated with the respective disposal path (pecuniary, transaction costs, spatial, sanctional) are considered. The result is a complex situation for regulation, not least because of a path of illegal disposal that is not easy to control, which makes it difficult to simply apply economic pricing instruments. Instead, the concept of 'hurdle management' is introduced, which offers a perspective for future regulatory efforts with regard to disposal costs.

ID: 339 | *Extended Abstract*

KEYWORDS: Circular economy; Product lifetime; Repair; Spare parts; Availability

Availability of spare parts and product lifetime in Brazilian consumer protection law

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In the circular economy, repair is an important strategy to extend product lifetime. Factors enabling product repair are manifold. One is the availability of spare parts. The text discusses how it is regulated by Brazilian consumer protection law as applied by courts and whether such a regulation favours the CE as envisaged by the country's National Circular Economy Strategy. In a continent-sized country where legislative and judiciary powers are shared, statutory law transfers to the Judiciary the task of determining the minimum period for the availability of spare parts, which must never be less than product lifetime. Case law is erratic and lacks harmonisation by the Superior Tribunal of Justice, the final appeal court. Decisions of state courts do not answer any of the following questions: (1) whether product lifetime is to be determined abstractly for product categories, like eco-design regulations in the European Union do, or concretely depending on product use by the consumer; (2) who is to provide the time frame in a legal dispute (i.e., the consumer, the OEM or the judge); (3) whether decisions are to be based on evidence produced by the parties or not. The lack of harmonised criteria to determine product lifetime runs counter to the National Circular Economy Strategy's objetive of creating a regulatory environment favourable to the CE. There is room for legislative improvement, which is particularly important in a civil law country like Brazil. The consumer protection code or its implementing decree should be modified to provide clearer time frames.

ID: 326 | *Extended Abstract*

KEYWORDS: Australia; Circular Economy; Policy Analysis; Disassembly; Deconstruction; Adaptive Reuse

Towards Building Circularity in Queensland: Policy Gaps in the Built Environment

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This study evaluates Queensland's policies supporting circular economy practices in the building and construction industry. Through systematic review, it reveals that while current initiatives have improved construction waste recovery rates, policies focus primarily on recycling rather than higher-order circular practices like deconstruction and material reuse. The research identifies opportunities for policy reform and incentives to advance Queensland's transition to a circular economy in the built environment.

THURSDAY

ROOM 4.105

ID: 132 | *Regular Paper*
KEYWORDS: Social norms; Sufficient-based consumption; Fashion; Sustainable behaviour; Over-consumption

Leveraging social norms for sustainable behaviour: How the exposure to static-and-dynamic-norm communications encourage sustainable behaviour towards reduction of fashion consumption

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Communication channels from social media to newspapers abound with examples where static norms, reflecting established behaviours (e.g., eating meat, drinking alcohol at parties) are combined with dynamic norms, illustrating emerging societal trends (e.g., adopting more plant-based diets, attending alcohol-free events). Despite widespread exposure to these combined static-and-dynamic-norm communications, their impact on consumer behaviour remains unexplored. Through two lab experiments, this research investigates how static-and-dynamic-norm communications influence sustainable behaviour towards a reduction of fast fashion consumption. Our findings show that consumers exposed to the combination of unsustainable static and unsustainable dynamic norm purchased significantly fewer fashion items compared to other experimental conditions. This effect is driven by social moral cleansing, as consumers, confronted with widespread unsustainable behaviour of others, felt a highlighted motivation to clean and compensate for the normalized bad behaviour of others by behaving more sustainably in return. This research advances the understanding of social normative influences on sustainable consumption and offers valuable insights for researchers, designers and policy makers. By identifying an effective social norm communication to encourage consumption reduction, it lays the groundwork for future research and policy initiatives aimed at promoting sufficiency in the context of sustainable behavioural change.

ID: 160 | *Regular Paper*
KEYWORDS: Wardrobe study; Wardrobe size; Wardrobe reduction; Sustainable fashion; Sufficiency

From excess to essential – Exploring the Potential of Adopting Smaller Wardrobes

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The overproduction and overconsumption of clothing have substantial environmental impacts. Shifting to smaller wardrobes containing fewer, durable, and frequently used garments is a key strategy in transitioning to a sustainable system. Understanding the size and composition of wardrobes is an essential first step to assess the potential of adopting smaller wardrobes. This study maps the current size of individuals' wardrobes, the fraction actively used, and the fraction individuals deemed essential to meet their needs. It moreover investigates the characteristics of essential garments and identifies barriers to adopting an essential wardrobe. To examine this, participants' wardrobes were first audited and then reduced to only those items deemed essential to meet their needs for the coming year. The wardrobe audit of 30 individuals in Flanders (Belgium) reveals that participants owned, on average, 169 garments, of which 138 were used in the past year (81%), and 90 were considered essential (53%). Participants' perceived essential clothing needs varied strongly, ranging from 36 to 275 garments, or alternatively, 28% to 98% of their current wardrobe. Combinability emerged as the most important criterion for selecting essential garments. Both practical (i.e., shortages) and emotional considerations (i.e., loss of joy) were anticipated as obstacles to adopting an essential wardrobe. This study highlights the considerable variation in how individuals meet their clothing needs and what they deem essential. Our findings provide an initial range for the minimum number of garments required to meet clothing needs and offer valuable insights for establishing sufficiency thresholds in apparel consumption.

ID: 294 | *Extended Abstract*

KEYWORDS: Creative research methods; Positive activism; Degrowth aesthetics; Engagement with nature; Response-ability

Creative research methods for engagement with nature, positive activism and the aesthetics of degrowth

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In this paper we will argue through examples, how the role of creative practices can be rethought in the time of multifaceted crises. We will present six creative research methods that could empower the dialogical partnership with nature and reconsidering our ways of doing, in order to move towards cultural, environmental and social resilience. We ask how can creative research methods promote our engagement with the rest of nature and support meaningful actions in the context of degrowth. The aim of these creative methods is to offer us and other practitioners inspiration for creative approaches to engagement with nature and the mentality of doing less, thus promoting these methods as possibilities for positive activism. Some of them do not propose much new in itself, but their contribution lies in practical application. They work the best if combined, interwoven and influenced by each other. They are meant for other designers, artists, researchers and to be applied to other fields and gardens as well. On the method cards we present the theoretical framework, exercises for the application of the methods and examples of how we have applied the methods as artists, designers and gardeners. We aim to present the developed methods in the form of open access method cards.

ID: 340 | *Regular Paper*

KEYWORDS: Pre-consumer waste; New waste; Multiple case study; ARA model

One man's trash is another man's treasure: Actor constellations to prolong the life of 'new waste' resources

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The overconsumption of finite resources and the growing climate crisis necessitate innovative approaches to waste management in manufacturing. This study investigates the untapped potential of redesigning waste materials—specifically, pre-consumer waste or "new waste"—to create value while mitigating environmental impact. Unlike recycling or disposal, this approach leverages the inherent qualities of discarded manufacturing materials derived from virgin resources, aligning with the European Union's waste hierarchy principles. Using a multiple case study methodology, we analyzed eight collaborations between manufacturing companies and industrial designers. The actor-resources-activities model was employed to understand how these partnerships foster redesign and prolong material lifespans. Our findings reveal that strategic actor roles and interactions are crucial in activating redesign potential, enabling the transformation of waste materials into new products. The crucial actor roles consist of industrial designer, waste owner, waste processor, and sales & distribution. The results highlight significant business and environmental opportunities, including cost reductions, and waste diversion from landfills. However, realizing this potential requires targeted interventions to facilitate cross-disciplinary collaborations and align objectives among stakeholders. By illustrating successful constellations of actors and processes, this research provides actionable insights into unlocking new avenues for circular economy practices in manufacturing.

SESSION 21

ID: 250 | *Regular Paper*
KEYWORDS: Clothing; Sufficiency; Perceived sacrifice; Sustainable consumption

Perceptions of sacrifice in the pursuit of sufficient consumption

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This study investigates the role of perceived sacrifice in the adoption of behaviours of sufficiency in clothing consumption. With the urgent need to reduce carbon emissions and consumption to stay within planetary boundaries, this research explores how consumers perceive and are willing to make sacrifices for sustainable consumption. The paper examines seven types of perceived sacrifices—functional, emotional, social, epistemic, conditional, financial, and time/effort—and their impact on the intention to adopt sufficiency behaviours such as reducing purchases, extending clothing longevity, shifting to second-hand items, and sharing clothes. The findings reveal that perceived sacrifices significantly and negatively influence the willingness to adopt these behaviours, with variations across different types of sacrifices and behaviours. This research contributes to the literature on sustainable consumer behaviour and offers insights for policy-makers, marketers and designers to promote sufficiency in consumption.

THURSDAY

ROOM 5.125

ID: 157 | *Regular Paper*

KEYWORDS: Materialisation; Visualisation; Experimental design-science education; Biobased recycling processes; Textiles circularity

Learning by Transforming: Widening Access to Complex Circular Economy Science using Experimental Design

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This paper presents a pilot pedagogical project exploring the potential of experimental design methods to engage students with complex scientific concepts, by focusing on translating these concepts specifically for a public audience. Conducted within the UKRI-funded Textiles Circularity Centre (TCC) at the Royal College of Art, the project tasked design students with designing an experience that can communicate the science of biobased textile recycling, an emerging circular economy process that is complex and typically inaccessible for laypeople. Framed as a process of translation rather than mastery, the project integrated interdisciplinary, multisensory, and speculative design and teaching methods to engage with a range of ways of conceptualizing and communicating complex science to a diverse audience. Students worked closely with scientific researchers, engaging with scientific materials and techniques, including enzymatic recycling and bacterial cellulose production. Through iterative development, the students produced Catalyst, a multisensory installation that employs tactile interaction, visual displays, and soundscapes to create an interactive material simulation of biobased recycling. The study identifies three key pedagogical outcomes with potential for application in wider contexts: enhanced technical comprehension, emotional engagement, and learner agency. We discuss the relationship of multimodal design methods to whole-systems thinking and learning. We propose that interdisciplinary, multisensory methods for enhancing complexity-oriented learning and public engagement, and raise possibilities to scale the model to other contexts that involve communication of complex information, as it may be able to activate new forms of learning and public engagement.

ID: 163 | *Extended Abstract*

KEYWORDS: : Repair; Design; Education; Didactic; Productive failure

Experiencing Design for Repair, educating circular practitioners

Bas Flipsen, Stefan Persaud

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In the bachelor program of the faculty of Industrial Design Engineering several courses focus on design for sustainability. Although these courses score "more than satisfactory" on student evaluations, attendance is low and decreasing over the course. Besides, coordinators of the parallel running design projects notice that students struggle with the integration of sustainability into the design solutions. To make sustainability more applicable, we developed a new master elective related to design for repair. In this course we explicitly implemented the productive failure pedagogy, where the traditional learning process is flipped from direct instruction followed by exploring, to exploration followed by instruction. In the design for repair course students work on client-based products, focusing on a demonstration model to show the improved fit of the product within a circular economy. In this extended abstract, we will present the course, one of the workshops, and the student's learning experiences. We analyzed the student's reflections on their learnings, their experience of the course, and the applicability of the course in future work.

ID: 216 | *Regular Paper*

KEYWORDS: Co-design; Circular business model; Circular economy; Circular ecosystem innovation; Collaborative innovation

From Matching to Making: A Canvas for Collaborative Circular Value Creation

Katherine A. Whalen, Sara Renström

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Co-design, which involves end-users in the design process, has emerged as a promising strategy for developing circular offerings focused on product longevity. However, creating such offerings requires collaboration not only with end-users but also between companies forming circular ecosystems centered on shared value propositions. While existing research highlights the importance of inter-company collaboration and co-design with end-users, tools supporting co-creation with both users and multiple stakeholders remain limited. This paper introduces and evaluates a prototype tool called the Collaborative Circular Value Canvas. The tool is designed to facilitate company collaboration in generating concepts for circular offerings, which can serve as structured inputs for co-design with end-users. This paper reports on testing the canvas in a pilot workshop. Initial findings suggest the tool's potential to foster inter-company collaboration and generate valuable inputs for a co-design process with end-users. However, further research is needed to validate its role in a co-design process and its ability to foster business models focused on product longevity. Additionally, the implications of using the tool in a digital format should be further investigated.

ID: 143 | *Regular Paper*

KEYWORDS: Communication; Circular design; Salespeople; Knowledge transfer

Communicating Circular Design: A ReSuit case study of embedding knowledge of circularity from design to wholesale to shop assistant

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This paper explores how garments, which have had circular design embedded within them, can be communicated in industry from the design department to wholesale, shop managers/assistants and lastly the consumer. The research was situated within the ReSuit project as a case study and was a collaboration between design researchers at Kolding School of Design, anthropologists at Behave Green and industry partner Bestseller. The research was conducted in two parts. Firstly, it investigated, through interviews, how designers communicate circular/sustainable design to wholesale. Secondly, a parallel study used interviews to investigate communication from shop assistants to customers. The findings show that designers find it complex to communicate sustainability and circularity embedded within designs to wholesale, and the information regarding these topics gets diluted as the overall information burden is seen as too overwhelming. It was also found that shop floor staff were not equipped to guide customers towards sustainable/circular choices and that the customers knowledge, though interested, is lacking. However, it also demonstrates a range of methods that brands could draw on to aid communication, namely overview presentations supplemented with physical visuals, diagrams, first-hand experience or changing the presentation location. Furthermore, aids were suggested, such as mini guides, QR codes and websites. This paper proposes that, to communicate outwardly, brands should first look inward, to educate/upskill their sales teams (Business-to-Business and Business-to-Customer) with fundamental sustainable/circular knowledge. The paper concludes that salespeople have the potential to play a pivotal role in the transition to a circular economy.

ID: 198 | *Regular Paper*

KEYWORDS: Secondary Benefits; Rebound Effects; Behavioural Mechanisms; Design for Sustainability

Behavioural rebound effects and secondary benefits of sustainability-oriented design: two sides of the same coin?

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Despite the growing body of research on the role of rebound effects (RE) in offsetting potential environmental gains, understanding of secondary benefits (SB) remains limited. SB are induced behavioural or systemic changes triggered by sustainability-oriented design that strengthen, rather than offset, potential environmental gains. To address this gap, this study aims to uncover the underlying behavioural mechanisms with the aid of a systematic literature review. A total of 59 relevant articles has been selected, resulting in the identification of 17 behavioural SB mechanisms. The mechanisms are clustered into five categories: identity, consistency, efficacy, goals, and motivation. For each mechanism, a definition, explanatory quote, moderator list, and source overview is provided. Although each mechanism is unique, similarities in mediators and moderators suggest an interconnected rather than isolated nature. An evaluation of the research trends indicates an increased number of examined interventions. Nevertheless, limitations regarding the diversity of interventions, the intention-behaviour gap, and self-report bias remain. After interpreting the results, potential connections between SB and RE mechanisms are addressed. This study concludes with three recommendations for research to develop a comprehensive understanding of SB mechanisms. Ultimately, this understanding could contribute to achieving the full environmental potential of sustainability-oriented design and preventing RE.

ID: 203 | *Regular Paper*

KEYWORDS: Rebound Effects; Design Thinking; Systems Thinking; Leverage points; Systemic Design

Leverage Points as an Analytical Framework for Preventing Rebound Effects: An Exploratory Study

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Despite global efforts toward sustainability, greenhouse gas emissions continue to rise, partly due to rebound effects (RE), i.e., systemic responses that offset the potential sustainability benefits of sustainability interventions. Designers often struggle to prevent RE due to dynamic complexities characterized by non-linearity, feedback loops, and delays. This paper explores how systems thinking, specifically the Leverage Points Framework (LPF), can support design activities in ideating and designing strategies for preventing RE. Through an exploratory case study of an electric car-sharing system, LPF and ideation techniques were applied to devise potential design strategies to prevent RE emerging from five identified RE mechanisms. Our findings suggest that integrating leverage points into the design process encourages a more systemic and comprehensive approach to ideation, expanding design opportunities towards the prevention of RE. We conclude that combining systems thinking with design thinking enhances the potential for creating effective, sustainable interventions and recommend further research to evaluate the practical potential of the proposed framework.

ID: 205 | *Regular Paper*

KEYWORDS: Disposable gloves; Single use products; Social practice theory; Practices for longevity; Focus groups

Hygiene practices in everyday Life: Exploring the adoption and environmental implications of disposable gloves

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The COVID-19 pandemic has led to increased use of disposable products, notably face masks and disposable gloves. While these items serve as a protective barriers against health hazards, they also pose significant environmental risks due to their resource-intensive production and waste generation. This study explores the adoption of disposable gloves beyond healthcare, probing their use and significance in the daily lives of Norwegian consumers. Employing social practice theory, the research investigates the underlying reasons and ways Norwegian consumers incorporate disposable gloves into various practices, and how more sustainable alternatives could be promoted. The methods encompass mobile ethnography and focus groups with Norwegian consumers. The findings demonstrate that disposable gloves are used to reduce health risk and enhance hygiene in daily life conveniently, consequently increasing waste. Alternative methods for increasing hygiene, such as reusable and longer lasting products or hand washing, are perceived as less hygienic and less convenient. Conclusively, the study sheds light on the complexities of changing material-practice entanglements and offers insights for developing more sustainable hand hygiene practices.

ID: 232 | *Regular Paper*

KEYWORDS: Relationality; Incontinence pads; Care; Durability; Practices

No Product is an Island: The Case of Incontinence Pads in a Nursing Home

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This paper critically examines product durability through an ethnographic study of incontinence pad usage in a Danish municipal nursing home. By focusing on incontinence pads—which are referred to as "diapers" in this setting—we demonstrate that their durability cannot be understood in isolation from their surrounding environment. Instead, diapers attract auxiliary products, which, when integrated into the care practices of the nursing home, take part in enacting the diapers' durability in distinct ways. We conceptualize these enactments as either supporting or challenging the durability of the diapers. Combining this ethnographic work with design theorist Arturo Escobar's interweaving of ontological relationality and design theory, we argue that durability should not be viewed as an inherent property of an object or as determined solely by its human users. Instead, we propose understanding durability as a relational effect that emerges from situated sociomaterial practices. This analytical move challenges modernist assumptions that separate subjects from objects and offers a more nuanced framework for analyzing product durability. Future research on product durability would benefit from adopting this relational approach, as it opens—we hope to show—new ways of thinking and designing with sociomaterial practices and for product durability.

ID: 183 | *Extended Abstract*
KEYWORDS: Rebound; Reuse; Second hand markets; Displacement; LCA; GHG

ReCommerce Rebound Effects- The case of second-hand apparel

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Reuse is a key strategy in circular economy transitions, aiming to extend product lifespans and reduce the environmental impacts of production. Reuse is seen as a particularly promising strategy in the case of apparel where product lifetimes are exceptionally short. In recent years recommence platforms, facilitating the sales of pre-owned (i.e. used) apparel have proliferated. Yet the environmental benefits ascribed to apparel reuse might be overestimated as many assessments fail to account for rebound effects. Using data on sales of over 11 million used items sold via eBay.com in the US, together with surveys of US consumers, econometric modles and environmentally extended input output (EIO) assessment, we find that rebound effects can erode 47%-55% of expected GHG reductions from apparel reuse. Our results indicate that the rebound effects from both re-spending and imperfect substitution leads a noteworthy reduction in the life cycle GHG emission savings associated with reuse of apparel. To the best of our knowledge, this work presents one of the first attempts to quantify rebound effects resulting from apparel reuse via secondary markets.

THURSDAY **ROOM 4.231**

ID: 113 | *Regular Paper*

KEYWORDS: Innovation governance; Re-purposing strategies; Waste management; Wind turbine blade materials

Re-purposing Wind Turbine Blades: Matching strategies and Innovation Governance Forms

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The decommissioning of wind turbine blades poses an escalating environmental and waste man-agement challenge, as the composite materials found in these blades are difficult to re-cycle and often end up in landfills. With the projected growth in retired wind turbine blades, the waste bur-den is expected to reach 40–60 million tons by 2050. Traditional disposal methods, like mechani-cal and thermochemical recycling, are costly and result in low-value materials. Repurposing pre-sents a sustainable alternative; however, matching decommissioned blades with appropriate in-dustrial applications requires an innovative governance approach. This study leverages insights from innovation governance research and proposes a conceptual model for reusing decommis-sioned blades, focusing on bridging the gap between potential suppliers and users in various industries. By examining applications in construction, agriculture, and re-newable energy systems, the study illustrates feasible repurposing strategies and explores the regulatory mechanisms needed to facilitate effective matching. Through expert interviews and case studies, the paper identifies barriers, such as logistical constraints and material degradati-on, and advocates for in-termediate and third-party governance forms to support this marketi-zation process. The findings highlight the importance of systematic matching mechanisms and regulatory frameworks in ad-dressing the wind turbine blade disposal issue, underscoring the need for collaborative efforts in shaping sustainable solutions for end-of-life turbine materials.

ID: 125 | *Regular Paper*

KEYWORDS: Reuse; Medical products; Value-chains; Reprocessing, Stakeholders

Matching reuse models to hospitals: Reframing value-chains for reusable medical products

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In the transition towards a circular economy, also critical sectors such as the healthcare sector need to be reviewed. A large portion of hospital waste consists of low-value, disposable consumables. Currently, the circular design strategies of reuse, maintenance, and repair in healthcare are predominantly applied to high-value products. This study proposes four reuse value-chain models specifically for small, low-cost medical consumables. Reuse models are distinguished on reprocessing location (internal or external) and product usage (shared or personal). Business model evaluation and value propositioning are used to gain understanding of the models and a co-creation session with a MedTech company verified these understandings. Our research sought to support manufacturers of reusable medical products by addressing the importance of the fit between the reuse model and the hospital's context (location, infrastructure, staffing, organisational structure, product volume and type). These context features, as well as the hospital's interest in reusable products should be documented in the tendering documents of the purchasing process. Internal reprocessing makes the hospital more self-sufficient but requires additional staffing for reprocessing and quality control. External reprocessing decreases the hospital's workload, but requires the involvement of additional service partners. For all reuse models, continuous communication and collaboration (feedback, training and guidance) between the hospital and value-chain partners are vital.

ID: 286 | *Extended Abstract*

KEYWORDS: Circular business model; Circular fashion; Product-service system; Fashion rental; Case study

Circular Fashion Success: Cross-Country Insights on Adoption of Circular Business Model Offerings

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Current research documents that similar types of circular business models appear across different geographic locations. In the textiles and apparel industry, companies like WOW Closet (Sweden), LENA Library (Netherlands), Ours (Spain), and Rent the Runway (USA) have embraced a similar circular business strategy: offering clothes for lease rather than purchase. Despite sharing this approach, their rates of success and adoption vary significantly, with two of them enduring for nearly a decade while the other two have ceased operations. These differences highlight the central question of this research: Why do similar circular business models succeed while others do not? To address this question, this research adopts a multidisciplinary approach, integrating business models and consumer research perspectives. It focuses on case studies of both successful and unsuccessful companies across diverse geographic contexts. As a first step, this analysis aims to 1) identify criteria for case study collection, including a definition of 'success' and 2) present a conceptual framework for analysing the case studies. This is done by a review of academic literature focused on the intersection of circular business models, circular fashion, and related research streams such as consumer research and innovation studies. Moreover, existing conceptual framework(s) for analysing the adoption of circular business offerings are reviewed. Ultimately, this research aims to advance circular business model knowledge by furthering understanding of how these models can be effectively designed and implemented.

ID: 191 | *Extended Abstract*

KEYWORDS: Second-hand clothing; Perceived value; Perceived quality; Price; Brand availability

Will it Make it to the Rack? An Investigation of Perceived Retail Value in Second-hand Clothing

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This study investigates the relationship between perceived value and the treatment of garments within the second-hand clothing economy, focusing on sorting, selection, disposal, and pricing decisions that occur in thrift shops. Building on a growing body of literature that examines the second-hand clothing market, we analyse data from 19 semi-structured interviews with key personnel from various thrift stores in Canada and New Zealand. Our findings reveal significant variability in the ratio of saleable to unsaleable donations, with reports ranging from most donations in "fair to good condition" to as high as 80% being unsaleable. Utilizing Sihvonen and Turunen's (2016) six antecedents of perceived value as a theoretical framework, we identify four themes—perceived quality, design, price, and brand availability—that significantly influence the evaluation of garments. These antecedents are shown to weigh differently depending on individual sorters and specific garments. The subjective nature of the condition of clothing emerges as a critical factor, influenced by the sorters' personal standards and perceptions. Furthermore, the findings highlight how factors such as evidence of newness or brand novelty can affect pricing and desirability. This research contributes to the understanding of second-hand clothing practices by focusing on the operational aspects of thrift shops, ultimately shedding light on the complexities behind the perceived value of garments in the second-hand economy.

ID: 237 | *Regular Paper*
KEYWORDS: DIY Materials; Material Driven Design; Materials Narrative; Material Potentials

Exploring material potentials for product design: In pursuit of a narrative-based approach

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This research proposes a narrative-based approach and two corresponding strategies as part of an interdisciplinary project. The approach could be an initial step in understanding the user's first impression concerning materials experience and other material potentials, informing designers about translating them into product design decisions. The project combines Material-Driven Design (MDD) and user-centred research methods to develop composite Do-it-Yourself (DIY) materials by upcycling textile and plastic wastes. It aims to transform these materials into seven products designed for office environments that promote sustainability. The project's design brief includes the product's primary function, context, and target group. However, the MDD process follows the material exploration to decide on the product proposals formed towards the end. That calls for an alternative method that adapts MDD to broader product development scenarios, particularly those guided by a predefined design brief, to enhance the value of Materials Experience (MX) in conventional design processes. This research initially implements a design probe study to address this gap and to understand forty-six office worker participants' first impressions of DIY material. Based on the study's findings and initial material tinkering process within the research group, a need for a contextual elaboration of materials to address material potentials holistically, including experience, form, function, and affordance, became apparent. Hence, a narrative-based approach is grounded with materials agency in mind and strengthened with anthropomorphism and material journey mapping strategies to obtain insights for the abovementioned scenarios.

ID: 241 | *Regular Paper*
KEYWORDS: Next-Gen materials; Blended textiles; Circular textile design; Recycling; Guideline

Compatible blending for circular textiles with next-gen materials

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Emerging next-gen materials such as recycled, renewable, or regenerative fibres promise lower impacts in resource extraction and transformation processes than their conventional fibre counterparts. These materials can be instrumental in a shift to a more sustainable fashion and textiles industry. A key contribution to this transition relies on reducing impacts and waste through circular design measures such as increasing lifespans and recycling at end of life. However, as these next-gen materials tend to have properties and costs that deviate from optimised industry norms, they are often used in incompatible blends, thus negating their circularity potential. This paper puts forward a framework to understand material flows and lifecycles as a relation between fibre type and recycling route for designers to operate within the principles of circularity. The research results in a guidebook to support designer's choices of material combinations in line with recycling trajectories, and in a series of samples produced by industry project partners and students demonstrating the application of the framework. The samples use a selection of five example next-gen materials, which are integrated to each practitioners' applications and aesthetics. The underlying aim of the research is to foster a systemic approach to textile design with an increased understanding of material properties and their relation to current and emerging recycling technologies.

ID: 341 | *Regular Paper*

KEYWORDS: Circular economy; Industrial waste; Product design; Discarded materials; Sustainability

Introducing the Reshape strategy: Preserving material integrity

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One of the significant challenges of today's society is the unsustainable overconsumption of resources, coupled with the generating of enormous amounts of waste. European manufacturing produces over 230 million tons of waste annually, much of which remains unaddressed within existing circular economy frameworks that predominantly focus on post-consumer waste. This paper introduces the Reshape strategy, which aims to respect, incorporate, and utilise pre-consumer industrial waste to create new products, thereby reducing dependence on virgin materials. Positioned within current R-frameworks, the Reshape strategy addresses a theoretical gap in circular economy literature, where the Recycling strategy is commonly used and Reuse often being misapplied, leading to theoretical ambiguity. Reshaping emphasises the extension of material lifetimes rather than downcycling through recycling. Therefore, this research explores the potential of industrial waste as a resource through 19 case studies from a Danish research project focused on designing with industrial waste materials. The findings emphasise the inherent qualities of industrial waste and outline activities within the Reshape strategy that leverage the material's integrity in terms of function, form, or material composition, thereby extending its lifetime. By leveraging these qualities, this study contributes theoretically to the circular economy by refining terminology and advancing the understanding of pre-consumer waste within circular systems. The Reshape strategy aligns with circular economy principles, aiming to keep materials in productive loops while addressing the significant untapped potential of discarded materials.

ID: 334 | *Regular Paper*

KEYWORDS: Remanufacturing; Longevity; Slowing resources; Steel Moulds; Manufacturing

Design for longevity in industrial products: a pedagogical case study on steel moulds for injection mould manufacturing

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The paper aims to demonstrate the life cycle costing and environmental impacts in different R-strategy scenarios focusing on steel moulds. Reuse focuses mainly on remanufacturing steel moulds and exploring the most environmentally optimal strategy, serving as one's supplier in a circular scenario. The scope of this case study does not include recycling scenarios. The study uses a pedagogical case study in collaboration with The LEGO Group. One approach is to map the CO2-eq footprint consumption of steel moulds to prepare for a digital architecture based on material consumption and circular strategy.

ID: 189 | *Regular Paper*
KEYWORDS: Use phase; Wearing; Underutilisation; Wardrobe study; Dress archetype

Idle and Active Dresses: Design Briefings from the Wardrobe

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This paper explores how a wardrobe study, the dress audit, was combined with literature on the dress archetype to create a brief for fashion design practice that aims to increase the active wearing of dresses. Overall, clothing utilisation has declined by over a third in the last 15 years, with dresses being the least worn of any significant item. Unworn dresses amount to hidden wardrobe waste, and increasing their utilisation could reduce fashion overconsumption. A cultural examination of the dress through a lens of sustainability reveals an archetype of the Western fashion system, tied to production and consumption discourses with complex socio-political dimensions. In contrast, the wardrobe study provided vital insights into dress-wearing experiences. Most dresses are now mass-produced, creating a disconnect between designers and wearers, and this paper highlights some of the implications of this divide. The wardrobe study identified three leading factors that impact wearing: fit, occasion, and style. If designers address these three factors alone, it could mitigate up to 80% of low usage issues. These findings helped develop five baseline parameters and create a new brief for fashion design practice that prioritises greater garment utilisation by incorporating the lived experience of wearing within the design process.

ID: 195 | *Extended Abstract*
KEYWORDS: Clothing Longevity; Australia; Consumer Behaviour; Durability; Clothing Lifespan

The influence of age, gender and income on Australians' expectations of clothing lifespan

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Extending clothing lifespans is a crucial step in advancing the transition to a circular economy. Past studies have highlighted the need to distinguish between social and technical lifespans of clothing (Laitala et al., 2018), as well as how/when to measure lifespan, whether in number of wears or number of years (Klepp et al., 2020). While research has been conducted on clothing lifespans in European contexts (WRAP 2019) and in Europe, Asia and USA (Laitala & Klepp, 2020), this area remains underexplored in Australia, which presents a unique cultural and economic landscape. This paper investigates the expected lifespans of clothing in Australian households. Factors such as age, gender, and income can significantly impact how long consumers expect their clothing to last. By examining these variables, this research can provide insights into consumer behaviour and preferences, which can inform targeted interventions and educational campaigns to promote sustainable clothing practices.

ID: 276 | *Extended Abstract*

KEYWORDS: Circular Business Models; Retail; Apparel; Sustainable Fashion; Consumer Engagement

Customer Engagement – When do Circular Business Models Pay Off?

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The apparel industry is under increasing scrutiny for its linear business model, which rapidly depletes natural resources, drives overconsumption, and generates waste. In response to growing awareness of the apparel industry's unsustainable practices, circular business models, such as buy-back and resale, offer a promising alternative. However, emerging research suggests that the availability of circular business models may, paradoxically, accelerate consumption. With policy incentives and regulatory frameworks promoting a circular textile economy and previous research highlighting both its potential and limitations, a critical question arises: When do circular business models pay off? This study investigates customer engagement in circular business models through a longitudinal case study of a Nordic apparel retailer. Drawing on four years of transaction-level data, we analyze differences in purchasing behavior between customers who engage in buy-back programs and those who do not. Our findings indicate that engaged customers tend to reduce their spending after participation, suggesting the potential for prolonging garment lifespan. However, these customers are typically highly loyal, raising questions about the heterogeneity of the group and the broader scalability of these behaviors. This study provides empirical insights and critical analysis of customer engagement in circular business models, offering valuable knowledge for businesses, policymakers, and trade organizations working to implement circular practices as a pathway to sustainability within the apparel retail industry.

ID: 167 | *Regular Paper*

KEYWORDS: Clothing swap; Collaborative consumption; Clothing reactivation; Clothing reuse; Wardrobes

Garment Reuse in Practice - Insights from a Clothing Swap

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Reuse is a key strategy to intensify the use of goods. Hence, clothing swaps are typically presented as a sustainable alternative to conventional fashion consumption. However, research into the mechanisms and dynamics behind these exchanges remains limited. Using qualitative and quantitative methods to study a swapping event in a city in Belgium, this study explores the potential of clothing swaps to enable the reactivation and reuse of clothing. The mass flow analysis reveals that about half of the garments brought to an in-person swap using an indirect exchange system found new owners. Certain garment types (t-shirts and sweaters) were more easily swapped than others (pants). Survey responses indicated that participants use swaps to hand off dormant clothing that is no longer suited to their needs. Further, participant stated that most of the garments they acquired will substitute the purchase of garments. When comparing the wardrobe composition of swap participants to a general sample, we found that swappers have a similar wardrobe size but a much higher fraction of pre-owned garments. Unexpectedly, swap participants had a slightly higher fraction of dormant garments in their wardrobes. The observed differences cannot be solely attributed to participation in swap events, as participants are likely also engaged in other reuse activities. Meaning it provides an important glimpse into the potential effects society-wide policies focused on increasing garment reuse could have on wardrobes. To summarize, by combining different methods, this study provides new insight into the dynamics behind swapping, and clothing reuse in general.

SESSION 27

ID: 234 | *Regular Paper*

KEYWORDS: Co-learning; Communal platform; Repair; Skill-sharing; Social connectedness

"Spring Cleaning": skill-sharing towards conscious clothing consumption

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This article discusses the case study of "Spring Cleaning", a one-off event comprising workshops sharing different approaches on extending the use-time of clothing and textiles. Through a qualitative approach, the study aimed to explore if a one-off event can have an impact on the application of skills learnt and how social connectivity contributes to that aim. A secondary aim was to determine if there was a demand for future iterations of this kind of event, in or beyond the university setting. Through the diversity of workshops offered, the event aimed to open up what the parameters of repair, reuse and revival in the clothing and textile sector can be, drawing attention to various timely topics through discussion and practice. These included the preservation of repair skills, celebrating the aesthetics associated with repair and fostering more caring, longer-term relationships with the material world.The findings, gathered through participant observation, a survey and follow-up questionnaire with both participants and facilitators, indicated that for the most part, the event had a positive and lasting impact on attitudes and behaviours around skill-sharing as well as benefits on the social and emotional sides. The sense of opportunity, fulfilment and inspiration was felt from all involved, regardless of their role. Limitations came in the one-off nature of the event, the participant demographic largely having previous experience in clothing or textile repair and in the amount of participant responses only accounting of one third of the total.

ID: 308 | *Regular Paper*

KEYWORDS: Social resilience; Repair-led design; Commons; Social impact; Co-design

Repair as a driver of community-led behavioural change

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Repair has been at the epicentre of place-based approaches led by communities/commons in order to sustain resources and address socio-environmental challenges. This paper presents the initiative Creative Industries, Social Enterprise, Repair and Restoration (CISERR) situated in regional Queensland, which is providing practical and social skilling to at-risk young men by employing creative repair practices. CISERR adopts repair as a wholistic approach targeting not only material restoration but also self and community renewal. To capture its social impact, all phases of the initiative were evaluated through an evolving Monitoring Evaluation and Learning (MEL) framework. The paper focuses on the third round of CISERR for which, the methodological approach and findings were divided in two parts. The participatory Narrative Inquiry (PNI) methodology was used for the first part while the Participatory Scenario Planning (PSP) method and a facilitators' workshop were employed for the second part. Interviews and visual data collection were conducted for both parts. The findings combined demonstrated how CISERR facilitated the development of adaptation skills related to possibilities of employment by exposing at-risk young men to creatively repairing and reusing local resources. They additionally made evident how CISERR's wholistic repair approach created the circumstances for a community to use its lived experience and place-based resources to support at-risk youth. The paper concludes with CISERR as an example of repair driving community-led behavioural change; the latter being a response to the growing need for social resilience and an antidote to the failed efforts by governments to activate individual behavioural change.

ID: 271 | *Regular Paper*

KEYWORDS: E-Waste; Sustainability; Lifespan; Repair Network; Circular Economy

E-Waste Management trend in Ethiopia: Strategies for Extending Electronics Lifecycles

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The rapid generation of e-waste poses a significant environmental challenge, necessitating sustainable approaches to managing electronic product lifecycles. This paper aims to investigate how repair practices in Ethiopia affect the lifespan of electronic devices. In Ethiopia, electronics tend to have slightly longer lifespans compared to those in other countries, primarily due to extensive repair and reuse practices. As a result, the average lifespans of LCD TVs, LCD monitors, laptops, and smartphones are 11.96, 11, 10.7, and 6.38 years, respectively. The study highlights the impact of repair and refurbishment practices on extending the lifespan of electronic devices while also revealing a growing trend in e-waste generation. Additionally, it benchmarks global e-waste policies, emphasizing adaptable strategies that prioritize lifespan extension through repair networks, incentivized reuse, and product design improvements. The findings advocate for enhanced collaboration among stakeholders, including repair practitioners, policymakers, and consumers, to implement actionable strategies for sustainable e-waste management. By fostering a circular economy, this research aims to contribute to environmental preservation and sustainable development in Ethiopia.

ID: 282 | *Regular Paper*

KEYWORDS: Repair; Visible mending; Product-life extension; User agency; Circular Economy

Making Mends: Visibly Mending the Circular Economy

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This paper introduces the Making Mends Workshop, a workshop format centering on the practice of visible mending as a means to explore broader notions of repair and care in the context of the Circular Economy. The workshop is structured into three parts: a reflective exercise that encourages participants to consider the practical and conceptual meanings of mending, a brief lecture and practice session that provides basic knowledge and skills of visible mending, followed by the participants repairing a personal item. Findings suggest the potential impacts of the visible mending workshop as a catalyst for fostering user agency through skill acquisition and meaning-making. The workshop highlights visible mending as a communal repair practice supporting the Circular Economy by extending product life and preserving material and emotional value. The notion of Mending for Others was identified as a valuable addition to communal repair, where repair strategies benefit from social interactions that involve sharing knowledge and skills, care, and joy, ultimately leading to durable repairs.

ID: 252 | *Extended Abstract*

KEYWORDS: Circular consumption; Consumer behavior; Product reuse; Effective interventions; Environmental impacts

Measuring the Impact of Smartphone Reuse Interventions on Consumer Choice and Product Lifetime – Preliminary Findings

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Our study investigates the potential of business and policy interventions to promote the reuse of smartphones within the circular economy. Despite the rapid growth of the reuse sector, many smartphones remain unused or are prematurely recycled, hampering growth of the second-hand market. Previous research has shown that reusing smartphones extends their lifetime, reducing the demand for new products and thereby avoiding the associated environmental impacts. However, the effectiveness of interventions promoting reuse has not been well established. This study addresses this gap by collecting consumer data on actual reported purchase and end-of-use behavior under current conditions (baseline) and under reuse-promoting interventions (hypothetical scenarios). We use this novel data as input to an existing market-level stock-and-flow model to evaluate the cumulative effects of interventions on consumer choice and the demand and supply of new and second-hand devices. Our analysis focuses on two interventions to demonstrate the method: (1) an extended warranty for second-hand smartphones and (2) a free data transfer and erasure service. Results from a pilot survey conducted in the US indicate that, under current conditions, 14% purchase second-hand devices, with an average use time of 2.8 years. An extended warranty could increase second-hand purchases to 22%, extend the average use time to 3.1 years, and reduce new production by 10%. However, the free data transfer service showed no significant impact. An idealized scenario in which everyone favors reuse showed a potential 44% reduction in new production with 60% of users opting for second-hand devices. Our approach enables us to quantify how interventions for reuse can influence market dynamics for new and second-hand products. Preliminary findings highlight the effectiveness of extended warranties in promoting smartphone reuse and demonstrate the need for supportive policies to achieve a more sustainable market. Future work is needed to broaden the input data set, expand to additional interventions, and account for diverse consumer behavior via segmentation.

ID: 238 | *Regular Paper*

KEYWORDS: Packaging; Circular Economy; Indicators; System-Based; Literature Review

Circularity Indicators for Packaging: A Literature Review and System-Based Classification

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The transition to a Circular Economy in the packaging industry is vital to address growing environmental problems. Circularity indicators play a critical role in evaluating progress and guiding decision-making. However, existing indicators lack suitability for packaging and do not factor in the systemic considerations required for successful transition to CE. This study identified 21 circularity indicators relevant to packaging, critically assessing their: suitability for the packaging industry; and inclusion of systemic considerations across lifecycle stages such as sourcing, design and production, distribution, use, and end-of-life. Using a three-point scale (extensive, partial and none), the indicators are classified to establish the extent to which they consider systems, such as Packaging Characteristic, Infrastructure, Value and Regulation. The analysis highlights several gaps, including overemphasis on end-of-life systems, limited consideration of value for stakeholders, insufficient alignment with upstream systems, and inadequate consideration of regional infrastructure and regulation. The findings underline the need for future indicators to adopt a holistic approach, integrating diverse systems to enable effective CE strategy implementation. By highlighting these gaps, this research lays the groundwork for developing robust indicators that not only assess circularity but also guide the packaging industry toward a realistic implementation of CE strategies.

ID: 296 | *Extended Abstract*

KEYWORDS: W)EEE; Repair; Reuse; Lifetime extension; LCA (Life Cycle Assessment)

Coupling LCA and product lifetime modeling to support repair & reuse: a case study in the WEEE sector

Guillaume Audrain, Laurène Cuénot

ecosystem, France

Representing about 5,000 Electrical and Electronic Equipment (EEE) producers, ecosystem is a Producer Responsibility Organization (PRO), i.e., a non-profit organization accredited by the French Public Authorities to organize and manage the collection, the repair, the reuse and the recycling of household and professional Waste of Electrical and Electronic Equipment (WEEE). Each year about 700,000 tons of e-waste is collected by ecosystem with 2% reuse, a trend that is expected to grow in the coming years to reduce the environmental footprint of the EEE sector. The "Anti-waste law for a circular economy" enacted in France in 2020 led to the creation of two financial funds aiming at supporting stakeholders of the reuse and repair sectors to extend appliances' lifetimes (French Code of Environment, Art. L541-10-4 / Art. L541-10-5). Handed with historical partners Emmaüs and Envie, about 1 million household appliances were reused in 2023. On the repair side, more than 100,000 repairs were realized in 2023 with the funds. To enhance and to give value to these activities, ecosystem enlarged its expertise to quantify the environmental benefits from repair/reuse. LCA to support repair and reuse An LCA was conducted based on a substitution approach (Tecchio et al., 2016; Ardente et al, 2018; Fangeat, ADEME et al, 2022). It is assumed in this work that the used product was either defective or a waste at the time ecosystem took a responsibility of if for extending its lifetime. Therefore, the product's first life is excluded from the scope.

Workshop 8: Ecodesign unleashed - help us to shape, implement and maximise impacts of the EU's policy for sustainable products!

(Room 3.107)

Matjaž Malgaj, Kathrin Kutlescha

A short interactive introduction to ESPR will be provided to then delve into a deeper exchanges/ discussion, giving participants a chance to provide active feedback to policy makers and jointly explore synergies. Participants get up to speed with the EU Ecodesign for sustainable product regulation and explore synergies and interlinkages with their scientific work. The session aims to be a catalyst for innovation & R&D, encouraging the adoption of circular design principles and fostering product-lifetime innovations supporting the aims of the Ecodesign for sustainable products regulation. Connect, network & engage with the PLATE design community to ensure involvement in future developments of the Ecodesign policy.

Workshop 9: Exploring product lifetimes from a product ecosystem perspective

(Room 4.105)

Lisbeth Løvbak Berg

The purpose of this workshop is to explore the potential of the budding research in the space of product ecosystems in a product lifetimes perspective. The term 'product ecosystem' is used in business to describe "value propositions based on interdependent products from multiple, independent firms" (Stonig et al, 2022). It takes into account the economy, the market, functionality and how products interact with other products (Tobias, 2027).

Consumption research shows that the product longevity is significantly shaped by factors external to the individual product, including interactions with other products (e.g., Laitala et al, 2024; Løvbak Berg & Hebrok, 2024). Product design approaches such as design for technical and emotional durability, do not take these factors into account and are therefore limited in their potential for increasing product lifetimes. There is a need for considering product longevity more holistically. The product ecosystem approach, however, considers competing and adjacent products and market dynamics.

Therefore, in this workshop, through mapping product ecosystems from the cases of furniture and clothing, we seek to explore how the product ecosystem approach could be beneficial when exploring the opposite of product offering, namely reducing product throughput and volumes. We ask:

- How can we build on the concept of product ecosystems to enable understanding not only of value propositions but also of product-product and product-user interactions?
- How can product ecosystem thinking shed light on how product volumes and life stages and events interact?

Workshop 10: 'How long will it 'laast'?' Rating strategies for designing longer lasting products using consumer archetypes

(Room 5.125)

Luke Harmer

The 'How long will it 'laast'?' workshop will be a participatory event aimed at evaluating strategies for designing products that last longer. In the group feedback session participants will discuss and evaluate approaches to extending product lifespans, tailored to different archetypes.

Industrial design students at Loughborough University were tasked with redesigning commonly replaced household products under the fictional brand 'laast'. Each student was provided with a specific product and archetype and asked to identify the most suitable strategies for enhancing the product's ideal lifespan. The archetype covers socio-economic factors, personal values and skills which will indicate end users' acceptance of/engagement with strategies that may drive repair tendencies. The students' goal was to redesign the product to better meet the needs and expectations of each archetype, and the possibility for that product to be the 'only… they'll ever own'. They were specifically asked to address simplicity, maintenance, repairability and functional fit to potential future scenarios.

During the workshop, participants will assess the effectiveness of these strategies against identified Key Performance Indicators and provide feedback on the appropriateness of the design responses. Participants will work in small groups onto large format printed sheets that showcases different design proposals for each archetype. Participants will be asked to rate the success of each strategy and provide detailed comments.

Participants specific area of interest and expertise will be used to form the groups. Insights from each group will be balanced afterwards with existing research on design strategies to increase product longevity.

Workshop 11: Mending a Leaf: A hands-on workshop for reimagining repair

Room 5.127)

Emma Huffman, Danika van Kaathoven

Mending a Leaf is a rapid, creative, and hands-on exercise in which participants are tasked to mend a leaf, followed by a group discussion about the thoughts, findings, and feelings they had in the process to explore broader notions of repair and care in (and out) of the context of the circular economy. The exercise was originally developed as the icebreaker of the "Making Mends" Workshop, a 3-hour-long workshop designed to practice visible mending and explore and strengthen the relationships with our garments. Mending a Leaf has been a useful and successful exercise to promote creativity and invites participants from all levels of mending experience to think critically about repair and care. The exercise aims to do two things. First is to let participants experience the steps of repair in a short time frame; observing, framing, planning, trying, failing, learning from and responding to the material, and trying again. Due to the unconventional prompt, most participants are faced with an unfamiliar challenge, which pushes their creativity and heightens their awareness of their repair processes. This connects to the second aim of the exercise: encouraging discussions about the broader meanings of repair and care. The marks of needle and thread on the leaf's surface, which was once a living entity, raise questions that reimagine the concept of repair. What does it mean to repair? How might we perceive brokenness? And for whom do we make efforts to repair?

Workshop 12: Secrets of the Mouse

(Room 4.231)

Stefan Persaud, Bas Flipsen

Repair and Design for Repair is needed to make products fit within the circular economy. Design for Ease-of-Disassembly is an important factor for design engineers to develop future-proof of products. Within the master elective at the faculty of IDE (TU Delft), students learn how to design circular ready products in several workshops as described in our paper "Experiencing Design for Repair, educating circular practitioners". This workshop will address one of the workshops, where you will explore the secrets of the mouse. What parts are important, and which disassembly activity hurdles the process of repair, refurb, and maybe even recycling.

Workshop 13: Uncover the beauty of repurposed design with the Re-valuate tool

(Room 1.229)

Christel Hofmans, Deborah Sumter

For sustainable product development there is an urgency to create designs that have a long lifespan and that are appreciated by the user. Amsterdam University of Applied Sciences has developed the Re-valuate tool for industrial designers to learn how product appearance can help improve consumer appreciation. The tool helps gather insights into how an aesthetic opinion on products comes about, so it can help designers (re)design desirable products that resonate with the target group.

The tool in general works in three different ways:

- As an instrument to establish a solid foundation in the design process of a new product, ensuring the design fits a specific context and/or target group.

- As an instrument to enhance an existing product design to make it more appealing to a target group.

- As a navigator to find clever and suitable applications for a certain material stream in a product design process.

In an interactive workshop where we present the Re-valuate tool we explain how makers can enhance product longevity and market acceptance through knowledge about visual appearance and consumer perception. We will specifically focus on (re)designing repurposed products made of material waste streams, since that is a big challenge for future product development. The tool has already been tested with students and designers in practice. Within this session we would like to present the tool to an academic audience and discuss its use and relevance. A discussion with the participants helps us to understand if this tool is beneficial, specifically in a repurpose driven design process.

DESIGN FOR LONGER LASTING PRODUCTS AND BUILDINGS · ENDURING CONSUMPTION · BUSINESS MODELS FOR LONGEVITY · REPAIR, CARE AND MAINTENANCE · PRODUCT LIFETIME MODELING · POLICIES FOR LONGER LIFETIMES · SUFFICIENCY AND DESIGN FOR LESS · REBOUND EFFECTS AND CRITICAL VIEWS ON PRODUCT DURABILITY · EDUCATION, TOOLS, AND GAMES FOR PRODUCT LIFETIMES · MATERIALS AND LONGEVITY · CLOTHING, FOOTWEAR, AND ACCESSORIES LONGEVITY · DIGITAL LONGEVITY

FRIDAY

ID: 321 | *Regular Paper*
KEYWORDS: Clothing; Repair; Service; Circular economy; Consumption

Consumers' interest in using clothing repair services in Finland

Essi Karell, Kirsi Niinimäki
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Sustainable consumption practices, including garment repair, are vital in transition to a circular economy. Engaging in garment repair through professional repair services is, however, not as widely adopted practice as one might hope. This paper focuses on clothing repairs in the Finnish context, aiming to understand how consumers perceive the use of clothing repair services and what might be the reasons for not using these services. An online survey was conducted in 2021 to address this topic as part of a collaboration between the FINIX research project and the Finnish retail and service network S Group. Based on 1,903 survey responses, consumers generally express interest in the sustainable aspects of clothing and recognize themselves playing an important role in extending garment lifetimes. The use of clothing repair services remains yet relatively moderate among Finnish consumers. Many are competent in repairing garments themselves and do not require professional help. Price and availability are other critical factors that discourage consumers from using such services. Establishing a viable repair business may be challenging, given the price levels consumers are willing to pay for garment repairs.

ID: 148 | *Extended Abstract*
KEYWORDS: Unsustainability; Overconsumption; Luxury fashion; Consumer behaviour

Can Promoting Fashion Innovativeness Move Traditional Luxury Consumers Toward More Sustainable Fashion Behaviours?

Lisa S. McNeill[1], Khaled Ibrahim[2]
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Despite increasing awareness of the need to either reduce fashion consumption, or consume in more circular ways, some fashion markets continue to grow in overconsumption and disposal of prestige branded and luxury products. This growth is particularly prominent in Asian markets, where demand for new luxury and prestige branded products continues to grow at significant pace (Dinh et al., 2024). This study attempts to unpick the drivers of this behaviour and identify what might shift these consumers toward more sustainable fashion behaviour in the future.

ID: 295 | *Extended Abstract*

KEYWORDS: Impulse buying; Post-purchase; Guided introspection; Reflective thinking; Mindful consumption

Why Do You Buy? Introducing a Reflective Café Approach to Foster Mindful Clothing Purchases in Generation Z

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Owning a wardrobe of ever-changing fashionable clothes enables young people to stay trendy, express individuality, and build a sense of community. However, this pursuit often results in impulsive purchases that lead to waste and environmental harm. Research indicates that 41% of Generation Z (Gen Z) consumers are impulsive buyers. This impulsive behavior reflects a motivational dilemma, as Gen Z seeks to balance sustainability values with their need for self-expression and social connection. Existing interventions to curb impulse buying mainly focus on the moment of purchase. However, limited attention has been given to the post-purchase stage, where reflective thinking can influence future consumption behavior. Addressing this gap, this study introduces the Reflective Café, a group-based reflection approach designed to encourage mindful clothing purchases among Gen Z. Developed through two stages, the Reflective Café combines insights from literature, introspective research, and generative sessions with Gen Z participants. Its design incorporates three key elements: group-based reflection to enhance engagement, visual communication to make abstract ideas explicit, and guided prompts for mindful yet creative self-expression. The six-month journey invites participants to explore recent purchases, understand their motivations, and identify consumption patterns through structured, collaborative activities. By transforming self-reflection into an engaging social experience, the Reflective Café fosters deeper awareness of consumption behavior and promotes more intentional and sustainable decision-making.

ID: 107 | *Regular Paper*

KEYWORDS: Clothing; Spirituality; Sustainability; Consumption practice

Exploring spirituality's location in sustainable clothing consumption through "Black Swan" narratives

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"Black swan" events (e.g., pandemics, natural disasters, war) often prompt individuals to clarify their self-concept and boost self-esteem with consumptive activities when their mortality is threatened. Research about the Covid-19 pandemic's effects on clothing consumption indicates that some consumers shifted toward more conscious clothing consumption habits, which may be associated with a desire for self-transcendence (e.g., spirituality). The purpose of this study was to locate spirituality's role in consumption practice that strengthens clothing's longevity. Narrative inquiry methodology was used to engage individuals who reported a spiritual experience relevant to their consumption during the pandemic. The study explores the nature of narrators' spiritual experiences, insights, and the clothing consumption practices and ideals that are informed by each narrator's spiritual framework, which is idiosyncratic and deeply personal. The pandemic is described by narrators in this study as an opportunity for personal growth and insight into the value of time and relationships. Narrators describe an increased spiritual consciousness, leading to a sense of interconnectedness and responsibility, beyond their own survival. Their empathy for others expands. Materiality is reevaluated in their spiritual sense of what makes a "good life." Most importantly, narrators squarely negotiate their identity through contemplative spiritual practices and reduce their need for external approval. This allows them to deepen their commitment to reduce or restrain their clothing consumption habits. The narrators illustrate how sustainable clothing consumption is itself a spiritual practice that results in greater freedom of expression and a more meaningful and satisfying experience with clothing.

ID: 194 | *Regular Paper*

KEYWORDS: Repair barriers; Product design; Household appliance; Consumers

Existing barriers to consumer repair of small household appliances from a product design approach: A scoping review

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Small Household Appliances (SHA) and their associated electric and electronic waste are a major concern for the EU, which is tackling this problem with an emphasis in repair as a key strategy to prolong product lifetime. The field of product design plays a fundamental role in the configuration of products to enable their future repair. Therefore, this study explores the main barriers that consumers face when trying to repair their household appliances through a literature scoping review focused on small household appliances, from the product design and the repair ecosystem aspects. This study proposes a novel classification at product system level and product-service system level barriers. The first level relates to the physical product and its repairability, while the second relates to the entire system surrounding the product and the repair experience. According to the literature, most relevant repair barriers from the product system level were 'Understanding of product operation' (specially 'Product complexity'), 'Product accessibility' (specially 'Difficult disassembly and reassembly'), 'Impossibility to repair', 'Obsolescence' and 'Safety concerns'. From the product-service system level, the most relevant were 'Economic factors', 'Consumer factors' (specially 'Lack of time'), 'Access to information' and 'Lack of support by OEM'. The discussion section points out that some of these barriers may be downplayed by shifting the mindset of the SHA industry, currently focused on cost reduction, towards quality and repairability. Finally, least mentioned barriers in the literature are worth of attention and shouldn't be forgotten, as they point to possible research gaps.

ID: 333 | *Regular Paper*

KEYWORDS: E-waste; Product Lifetime; Waste Management; Obsolescence; Sustainable Design

Is This the End? - Lifetime of Electrical and Electronic Equipment

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The rapid advancement of technology, coupled with global digitalisation and the growing demand for innovative consumer electronics, has led to a dramatic increase in the production and consumption of electrical and electronic equipment (EEE). This trend has raised significant concerns regarding the sustainability of EEE usage, particularly in terms of their obsolescence, disposal, and environmental impact. Addressing these concerns, this study surveyed 600 undergraduate students, who reported on 14 different types of EEE, to explore the reasons for obsolescence (RQ1), the most common methods of managing obsolete devices based on their types (RQ2), and students' awareness of alternative waste management methods (RQ3). Results were reported using frequencies and percentages. Findings reveal that obsolescence is mainly driven by "broken beyond repair," "worn-out technology," "outdated technology," and "lack of required functions," indicating that absolute and technical obsolescence are the primary factors. The most common way of dealing with obsolete devices is to "keep it" across all device types, with "throwing away" emerging as another frequent method for electrical devices. More than half of the students are aware of accessible alternatives, such as "online sales" and "charity donations," though irregular or infrequent options tend to have lower awareness levels. This study highlights the behavioural trends and gaps in awareness among students regarding EEE obsolescence and disposal, emphasising the importance of promoting sustainable practices and raising awareness about accessible waste management alternatives.

ID: 313 | *Regular Paper*

KEYWORDS: Second-hand textiles; Sorting; Stain removal; Repair; Sustainability

Treat and Clean: A pilot study in stain removal and mending of substandard thrift store donations

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The growing prevalence of textile waste, largely driven by the fast-fashion model, necessitates a shift towards a circular economy that prioritises the reuse of materials. In Canada, the textile donation landscape is primarily managed by charities and for-profit organisations, which often rely on public donations to generate revenue. Despite high donation rates, many items received by thrift stores are unsuitable for resale, creating challenges for organisations dependent on volunteer labour. This paper discusses the Treat & Clean pilot study, part of a larger investigation into the quality and type of clothing donations received in Canadian thrift stores. The project aimed to assess the feasibility of rejuvenating so-called "substandard" clothing through cleaning and repair techniques, allowing these items to be resold. In total 4946 textile items donated to two large non-profit thrift organisations at nine separate store locations within Alberta and Saskatchewan were sorted. A significant portion of the donations were deemed unfit for immediate resale. A subset of sorted items (N=2271) was analysed off-site and considered for the Treat & Clean pilot. The effectiveness of the pilot was evaluated by analysing the success of treatments (e.g., stain removal) and tracking the resale of treated items. Results indicate that enhancing the quality of donations through simple cleaning and repair methods can increase the likelihood of their sale, thereby promoting sustainability in local communities. This study highlights the importance of increasing consumer awareness regarding donation quality.

ID: 258 | *Regular Paper*

KEYWORDS: Performance Swimwear; Sustainability; Durability; Longevity; Aftercare

Improving the sustainability and durability of performance swimwear through consumer knowledge and usage habits

Bridget Upton, Alana James

Northumbria University, United Kingdom

As with any sport, the desire to progress in swimming by any means is unending. There are constant advancements being made in the textile technology of performance fabrics, with most technologic developments being focused on synthetic fabrics. Synthetic fibers, such as polyester can take from 20 - 200 years to degrade and can release a range of chemicals having a detrimental effect on the planet (Uren, 2024). This paper explores performance swimwear's environmental impact and proposes solutions for both industry and users. Key issues include reliance on synthetic fibers, fabric deterioration, and insufficient consumer knowledge about reducing environmental impact and extending garment longevity. The study begins with a comprehensive literature review, which dissects the issues at hand and begins to deliberate possible solutions. Gaps in knowledge were identified and addressed through a series of qualitative interviews to gain first-hand insight from consumers and users of performance swimwear. The findings suggest that consumer knowledge around aftercare is insufficient. There is a lack of communication from brands on this subject, as well as a reluctancy from consumers to seek out this information. Thus, the common areas of wear and lack of knowledge on aftercare result in premature disposal of swimwear. The suggestion of designing for emotional durability presents a potential solution to increasing the longevity of swimwear. In addition to this, implementing up-cycling schemes could reduce environmental impact and improvements in aftercare such as better communication and access to information is recommended.

ID: 289 | *Extended Abstract*
KEYWORDS: Circular Economy; Behavior Change; Gamification; Artificial Intelligence; Smart City Mobile Application

From Clicks to Circular Behavior: A Smart City Mobile Application Leveraging AI and Gamification

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The transition to a circular economy requires not only transforming production systems but also reshaping consumption behaviors to address pressing environmental challenges. However, fostering circular behavior remains complex, as it involves breaking established routines and navigating fragmented consumer journeys. While digital tools are increasingly recognized for supporting sustainable consumption, most focus on isolated phases of the product lifecycle, and the growing number of separate apps can overwhelm users. From a circular perspective, it is essential to support consumers holistically across acquisition, use, and disposal to extend product lifespans and recover valuable resources. Against this background, this research explores how digital tools can engage users more comprehensively throughout the entire circular customer journey. It introduces a multifunctional mobile app that integrates AI and gamification to support circular behavior. The app aims to consolidate key functionalities within a single platform and to reach users at a critical touchpoint—when they are already considering disposal and thus more open to alternatives such as reuse, repair, or conscious acquisition. Following a design science research approach, the app is being iteratively developed and tested in a pilot city through expert interviews, workshops, and user focus groups. Ultimately, it seeks to offer a scalable solution for other smart cities aiming to promote circular consumption practices.

ID: 290 | *Regular Paper*
KEYWORDS: Circular Economy; Educational Games; Scientific Communication; Waste Prevention; R-Strategies.

Waste What? — A game to communicate about local circular economy practices

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Waste What? is a card game, intended to communicate about linear economy while highlighting sustainable alternatives of local circular economy (CE) practices offered by grassroot initiatives. The objective of this article is to present the applied co-creative game development process and to show identified CE enablers included in the game. Based on the results, lessons learned and recommendations for future projects are formulated. The project that developed Waste What? used a co-creative development process with four phases: 1. Field Trips: That collected perspectives, insights, and impressions from local CE-Stakeholders. 2. Prototyping: Developed the game concept based on observations. 3. Testing & Design: Prototypes are developed into the final game by including the perspectives of stakeholders in testing sessions. 4. Dissemination and Documentation: The game was documented and published with an open-source license and disseminated at events. With an individual design of 110 cards, a game board, chips, and a manual, Waste What? communicates an experience of involvement in local CE- practices. In the game, players from two teams take the perspective of CE-initiatives. They are active in the re-use of items of the categories: Textiles, Electronics, Food, Furniture, Construction Materials and Bicycles. Players have several options, including selling, donating, storing, combining or incinerating items. The game communicates observed CE-enablers connected to people, items, and infrastructure. The study concludes that CE-games can communicate principles and people are interested in the approach. However, it is recommended to tailor games to specific target groups and plan extensive dissemination efforts to maximize its impact.

ID: 310 | *Regular Paper*

KEYWORDS: Circular tools; Lifecycles; Open-ended design; Obsolescence; Design for a circular economy

Examining longevity in tools for a circular economy

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Industrial production contributes significantly to ecological sustainability challenges. One guiding approach to address these challenges is the circular economy. Slowing down resource flows is one of the main strategies of the circular economy. This involves extending the lifespan of products within and across multiple life cycles and increasing their utilization intensity. Various tools have been developed to support companies in adopting circular economy practices. This study examines how these tools facilitate designing for product longevity. Specifically, the study analyzes 10 tools — five recent tools identified in academic literature and five first emerging through internet scraping. These tools are annotated and coded to reveal qualitative insights regarding the level of longevity they address (theoretical and methodological insights) and how these tools help handling longevity-related aspects (practical and applied insights). The findings highlight how these tools contribute to extending product lifespans and identify the extent to which they could support slowing down resource flows.

ID: 141 | *Regular Paper*

KEYWORDS: Sustainable Clothing Consumption; Citizen Engagement; Behaviour Change Techniques; Lifetime Extension

Citizen Engagement Activities: Applying Behaviour Change Techniques in Sustainable Clothing Consumption

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The study explores the application of Behaviour Change Techniques (BCTs) in promoting sustainable clothing consumption. The fashion industry significantly impacts the environment, and despite consumer interest in sustainable options, adoption remains low, and a green gap persists. This research aims to identify effective methods to encourage sustainable behaviours. BCTs, a theoretical framework originally used in health contexts, are applied here to sustainable clothing consumption. Four citizen engagement activities were conducted, each incorporating different BCTs. Surveys were conducted before and after the activities to measure their effectiveness. The study found that certain BCTs (providing information on social and environmental consequences, education, and instructions on how to perform behaviours), significantly correlated with participants' intentions to adopt sustainable clothing consumption behaviours. These findings suggest that interventions combining impact awareness through information with action are most effective. The study highlights the potential of BCTs to guide and evaluate interventions aimed at reducing the green gap in sustainable clothing consumption.

SESSION 32

ID: 120 | *Regular Paper*

KEYWORDS: Circularity; Durability; Garment Testing; Ranking; Longevity

Measuring Physical Garment Durability: An assessment of 47 T-shirts

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Designing for durability, both physical and emotional, has been identified as non-negotiable in the battle against overconsumption, underutilization and the devasting effects of climate change. There is currently no consistent method of measuring physical garment durability or the ability to compare garments on the market. This study presents a reproducible and novel method for measuring and ranking the physical durability of 47 t-shirts. Multiple durability factors were used to modulate the ranking whereas previous studies have only reported on single factors to evaluate durability. The benchmarking results reveal that price cannot be used as an indicator of durability and that fabric composition does influence the physical durability of a t-shirt. The garments in this study were donated by the signatories of the Waste Resource Action Programme's (WRAP) Textile 2030 initiative as part of their strategy to reduce the environmental impact of UK fashion.

ID: 131 | *Regular Paper*

KEYWORDS: Circular Fashion; Durable fashion design; Design Tool; Material Selection

CircularMAT: Materials Advisor Tool to promote circular material selection in fashion design

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Discussing fashion entails revisiting history through both individual and collective expressions. However, the narrower meaning traditionally associated with the term has, for centuries, referred to the replacement of the old with the new—something that better reflects the Zeitgeist. By embracing the spirit of the time, fashion has evolved in response to today's uncertain future and precarious environmental conditions, moving beyond impulsive opulence toward sustainability. The sector may now be prepared to adopt a new definition of fashion as something not transient, but rather enduring. Durability is a cornerstone of the circular economy model, which seeks to keep materials and products in regenerative production cycles for as long as possible. In this context, the present paper introduces CircularMAT, a practical material advisory tool developed to support fashion designers in selecting materials that promote durability and enable circular design strategies. CircularMAT offers a structured system for material exploration, providing comprehensive information on traditional, preferred, and emerging materials. It links material characteristics to core principles of circular fashion and maps them against design strategies intended to extend product lifecycles and reduce environmental impact. The tool is designed to integrate seamlessly into the designer's workflow, fostering conscious and informed material selection decisions during the early stages of the creative process. By emphasizing the relationship between material properties, durability, and circularity, CircularMAT supports the adoption of more sustainable design practices—without compromising creativity.

ID: 299 | *Extended Abstract*

KEYWORDS: Rain jacket; End-of-life; Failure; Durability; Functionality

Analyzing durability and failure of workwear rain jackets

Janani Thiyagarajan, Mikael Bäckström, Judith Waller

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The European Union is placing significant emphasis on the durability of textiles as a critical aspect of sustainability, but there is currently no universally accepted method to systematically test and evaluate textile durability. Technical workwear garments, which form a substantial segment of the textile industry, are particularly relevant in this context due to their demanding functional requirements. This study focuses on identifying factors affecting the functionality and durability of workwear rain jackets to be able to understand the reasons for failure and end of life. A detailed visual inspection combined with functional testing of end-of-life jackets revealed the presence of both critical and non critical failures. Critical failures included membrane failures, holes in the garment and faded or stained outer fabric. However, some critical failures, such as broken zippers and sewn reflective elements were identified as repairable. Non-critical failures included minor damage to the fabric, velcro wear on non-essential areas and lining pilling. The study highlights the challenges in estimating durability and the need for a more comprehensive approach to assessing the longevity of rain jackets, particularly in technical workwear. The results show that visual inspections alone do not always correlate with functional performance, suggesting that although valuable to get an indication of a garment's overall state, durability testing methods need to take into account realistic use and maintenance. The study emphasizes the importance of aligning product design, procurement processes, and sustainability goals to eliminate common causes for failure, and extend the lifespan of workwear rain jackets.

ID: 142 | *Regular Paper*

KEYWORDS: Workwear; Assessment Criteria; Reuse; Longevity

Defining Worn Out Workwear: exploring how to assess garments for reuse within a laundry system

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This paper explores how to create an objective assessment criterion for 'worn out' workwear within an industrial laundry system. Undertaken during the ReSuit project, the research used Elis (laundry service provider) as a case study. Four styles of clothing light workwear (2x t-shirts and 2x trousers) were selected because they represented the products with highest numbers of discards. During a field study, the researchers visually analysed a week's worth of these discarded garments for a variety of types of wear and tear. The research found that wear and tear could be categorised across four themes: holes, stains, pilling and colour. A traffic light system was created in which garments were assessed as Green: Reusable. Yellow: Normal wear and tear with the potential for reuse. Red: Worn out (discard for recycling). From this assessment guides were created, both digital (to be printed) and physical (exemplars). Working within the limitations of the research, these guides did not provide definitive definitions of worn-out workwear, rather where to 'start the conversation' of where the line is drawn between reuse and discard within the workwear sector. This research concludes that there is a huge potential for the workwear sector to reuse clothing and extend the lives of the products and further research should seek to streamline and test worn out workwear assessment criteria.

ID: 275 | *Extended Abstract*

KEYWORDS: Circular economy; Design for circularity; Reuse; Computational kinematics; Linkages

Computational Circular Design of Planar Linkage Mechanisms Using Available Standard Parts

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To date, public effort in Circular Economy has been focused on low value retention strategies like recycling, higher value retention solutions are needed to better achieve a truly circular economy. Remanufacturing and repurposing are two high value retention strategies that focus on the reuse of existing parts of a product to create another product with the same and different function, respectively. These two strategies are already being explored in the building sector, where the creation of a database of available parts enables the reuse of building components. However, for products with moving parts, current research lacks systematic circular design methods. This paper aims to address this gap by focusing on kinematics, specifically on linkage mechanisms, which are ubiquitous in modern machines across industries such as automotive, agriculture, and manufacturing. Though numerous works in kinematic analysis and synthesis have been conducted, these methods cannot be transferred directly into a sustainability context as they assume an unconstrained supply of parts, both in terms of their number and geometry. This paper presents a computational method for synthesizing planar linkage mechanisms based on available standard parts, represented by LEGO® Technic beams. First, an adapted design representation is introduced, along with a generative method to create mechanisms and their coupler curves based on a given inventory. Next, an optimization problem is formulated to address the inverse design task. The goal is to find combinations of reused and new parts that produce coupler curves as similar as possible to a given target curve.

ID: 221 | *Regular Paper*

KEYWORDS: Lithium-ion batteries; Multi-regional input-output analysis; Recycling; End of Life; Socio-economic impacts

Assessing socio-economic impacts of Lithium-Ion Battery recycling through Multi-Regional Input-Output Analysis

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The expected rise in electromobility and the increasing use of lithium-ion batteries (LIBs) is generating new challenges and opportunities, particularly in the End-of-Life (EoL) management of batteries. One of these challenges are the socio-economic impacts associated with the EoL process steps on which this paper focuses on. With the method of Multi-Regional Input-Output (MRIO) analysis, a selected recycling process route in Europe is assessed regarding socio-economic impacts, first at current demand (baseline scenario) and followed by an upscaled demand. The results provide insight into differences in some socio-economic impact categories, such as employment, vulnerable employment, and worker remuneration. The scale-up scenarios show, among other things, an increase in the workforce and remuneration (positive impact). However, with an increase in vulnerable employment, negative socio-economic impacts are also evident in Europe-centered recycling processes. The results furthermore show that changing recycling processes can lead to sustainability trade-offs. Due to the limited number of indicators in the selected method, it is not possible to provide an overall picture of social impacts. However, this research shows a clear change in the individual impacts, which underlines the need for proactive measures to overcome infrastructure problems, expand recycling capacities and improve employment conditions in all sectors.

ID: 307 | *Regular Paper*

KEYWORDS: Ecodesign; Design for Sustainability; Sustainable Materials; Materials selection; Household Appliances

Towards an integrative approach for ecodesign principles and sustainable material selection. A systematic literature review to explore scholarly contributions at the intersection of materials, sustainable design and household appliances

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Through a systematic literature review the scholarly contributions at the intersection of ecodesign, sustainable material selection, and the household appliance sector are explored. A comprehensive search was conducted on the Scopus database, yielding 181 initial results, which were narrowed down to 52 relevant documents for in-depth analysis. Notably, the review revealed a growing research interest in these areas, particularly since 2015, reflecting broader industry trends towards circular and sustainable production models. Key findings include the identification of eco-innovation drivers, approaches for sustainable product design and assessment, and the importance of validating research outcomes through real-world case studies. The analysis also pointed out an evolution in sustainable design strategies and material selection focus, shifting from sole materials recycling towards durability, repair and life-extension. Some overarching themes emerged across the reviewed documents, including the application of Life-Cycle-Thinking approaches together with LCA-based methods and a general push to foster the implementation of ecodesign strategies in early design phases to maximize their effectiveness. The review also allowed to identify and visualize a network of scholars focused on appliance-related research works. A significant finding is the relative scarcity of research that effectively aim at integrating ecodesign and material selection specifically for the appliance industry.

ID: 331 | *Extended Abstract*

KEYWORDS: Circular fashion; Materials; Waste; Upcycling; Longevity.

Circular fashion and new materialities from repurposing waste: A discussion on the opportunities for the valorisation of material design from and for wearable garments

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The fashion industry is making a transition towards more sustainable practices by including design strategies that integrate the principles of the circular economy, considering its implications on the production and consumption system. This adoption is transforming the traditional logic of make, use and dispose towards a paradigm shift that gives responsibility to the designer and the user. This article seeks to to question the concept of waste in production systems and contributes to the discussion, with a focus on material innovation, focused on alternatives for new materials in and from the textile industry. From a waste management perspective, circular design considers upcycling, recycling and downcycling as economical ways to preserve material value. This perspective encourages discourse around the integration of sustainable strategies and symbolic perception in design from fashion waste, emphasizing the potential of new materials to challenge the longevity of both materials and designed garments.

SESSION 33

ID: 279 | *Regular Paper*
KEYWORDS: Biobased lighting fixture; Biocomposites; Bacterial cellulose; Material longevity

Longevity and Biodegradability Assessment of Biobased Lighting Fixture Design for Interiors

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Biobased materials are often associated with fast degradation due to their inherent biodegradability, limiting their adoption in long-term applications. This study explores the dual potential of biobased composites, particularly bacterial cellulose-based materials, through the case of lighting fixture design in interior spaces. While these materials naturally degrade under specific environmental conditions, their lifespan can be extended significantly through thoughtful design and controlled usage. The research involves a four stage methodology to focus on developing and testing composite materials by combining bacterial cellulose biofilms with various biobased agents to enhance light transmission and durability. The study then evaluates the performance of these composites in terms of illuminance quality and biodegradation in interior use and composting, comparing them to one of the conventional lighting fixture materials, polypropylene plastic. The results have shown that this study challenges the perception of biobased materials as inherently fast-degrading due to maintenance requirements, by demonstrating their capacity for longevity when utilized in stable indoor environments. The findings contribute to biodesign discourse by showcasing how biobased composites can balance biodegradability and extended usability, offering innovative pathways for a variety of ecological design applications.

FRIDAY

ROOM 3.107

SESSION 34

ID: 255 | *Regular Paper*

KEYWORDS: Collaborative Ecosystem; Strategic Design; Sustainability Transitions; Furniture

Designing a collaborative ecosystem for sustainability transition in the furniture industry: the Opendesk case

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Humanity faces a period of changes, leading to a global transition with unpredictable outcomes. Design can play a key role in guiding society to face these challenges, helping the different socio-technical system stakeholders cope with the sustainable transition. The change towards more sustainable economic and social systems requires the design of products and services and new business models and integrated systems that deliver them. This implies shifting from individual company thinking towards coalitions and partnerships like collaborative ecosystems. The furniture industry is facing a sustainable transition, therefore, companies and the market are experimenting with new approaches, including collaborative ecosystems. Because of this, it's important to understand how design can contribute to the definition, creation and development of a collaborative ecosystem for sustainable transition in the furniture industry. The article adopts the single case study methodology, proposing the analysis of Opendesk, a furniture delocalised network. The research shows how the design mindset has enabled Opendesk to create a scalable, flexible and resilient business that values system stakeholders and local production. It was possible to address the challenges of building and maintaining a community and network, creating engagement through design. Through the design mindset in the collaborative ecosystem, it was possible to help local manufacturers to be efficient and economically viable, allowing customers to contribute to the local economy and value. The case study shows the potential of design to catalyse relationships for fruitful collaborations between stakeholders with different goals and provide systemic innovations.

ID: 342 | *Regular Paper*

KEYWORDS: Consumer electronics; Circular economy; Electronic waste; Sustainability; Ownership perception

Exploring Consumer Behavior on Product Longevity as a Pathway to Product-Service System Adaptation

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The growing environmental challenge of consumer electronic waste has become increasingly urgent. It is estimated to reach 82 million tons by 2030, emphasizing the need for new radical strategies to address and reduce this impact. This paper examines product-service systems as a possible approach to minimize this waste and extend overall product longevity and circularity. Twenty participants' relationships with their electronic devices and perceptions of product longevity and ownership were explored. These insights provided a basis for identifying the opportunities and challenges of adapting PSS in consumer electronics. A recurring theme from the qualitative data was strong psychological resistance and a low willingness to relinquish control by leasing products for a monthly fee compared to retaining ownership. A six-step model was created to address these barriers and offer clear guidance on the key aspects to focus on when implementing PSS. This model advocates for a gradual transition to a product-oriented approach, where consumers maintain ownership while companies offer services such as maintenance and upgrades instead. The model encourages companies to take responsibility for repairs, generating additional income, strengthening customer relationships, and promoting environmental sustainability. The model emphasizes consumer trust, clear communication on environmental benefits, and offering flexible, consumer-friendly solutions.

ID: 261 | *Regular Paper*

KEYWORDS: Experimental collaboration; Participatory business model innovation; Community-based urban upcycling; Product and resource longevity

Transformative and community-based participation in collaborative business model experimentation for urban upcycling

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Across cities and urban regions in The Netherlands unusual collaborations emerge which aim to develop new circular business models that facilitate product and resource longevity through various upcycling strategies, such as reuse, repair, refurbish, repurpose and/or remanufacture. Municipalities, social entrepreneurs as well as multinational enterprises use various experimentation methods to initiate, test or improve new collaborations in urban upcycling. However, little is known about the role of transformative stakeholder participation in these experiments and how they affect business models for upcycling. Therefore, this study investigates how initiators in urban upcycling use transformative and community-based participatory experimentation to develop collaborative circular business models that facilitate upcycling in a city context. Through a multiple case study approach, this research contributes to literature on circular business model innovation by investigating how practitioners in urban upcycling collaboratively develop, test, implement and scale business models for product and resource longevity in a city context.

ID: 152 | *Extended Abstract*

KEYWORDS: Design; Reusable Packaging; System Design; Circular Economy; Sustainability

Implementing reusable packaging systems: lessons from industry

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Single-use plastic production continues to rise. Reusable packaging systems (RPS) are seen as a potential strategy to reduce single-use reliance. Some industries have trialled reuse systems. This article presents key findings from 40 industry interviews, highlighting the potential barriers and benefits of establishing RPS. Findings suggest industries struggle to secure adequate investment due to percieved risk. Designing reuse systems effectively to consider potential pitfalls prior to implementation can help to improve reuse feasibility. By presenting key industry learnings, this article aims to streamline the design and implementation of future reuse systems.

SESSION 34

ID: 323 | *Regular Paper*
KEYWORDS: Reuse; Remanufacturing; Critical raw materials; Product-as-a-Service; Battery

Enhancing Critical Raw Material Usage through Battery Cell Extraction and Reuse

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This paper proposes a circular economy business model for recycling and remanufacturing Bosch gen 3 batteries to enhance sustainability and economic viability. The model integrates collection, robotic disassembly, and state-of-health-based categorisation to extract the most valuable, reusable cells and then tests a battery remanufacturing option to maximize profit and critical raw material recovery. Two collection methods are analysed: incentivized returns (Option 1) and battery waste sorting at recycling centres (Option 2). A Monte Carlo simulation evaluates profitability with several uncertainties, including logistics and deposit refunds. Option 1 is more likely to obtain higher-quality cells, but is less likely to be profitable due to the high costs associated with the incentive, while Option 2 is more cost-effective, but yields lower-quality cells. This study highlights opportunities to optimize incentives and recycling value, providing a scalable framework for sustainable battery end-of-life management.

FRIDAY

ROOM 4.105

ID: 314 | *Extended Abstract*
KEYWORDS: Repair; Repairability; Circular economy; Obsolescence; Barriers to repair

Dealing with barriers to repair from the repairers' perspective

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Repair is a key component of the circular economy paradigm and holds great environmental potential. Our current linear economies, which rely on constantly expanding markets, are not conceived to be restorative and hence create structural barriers to repair. Through semi-structured interviews and questionnaires we explore the commercial repairers' perspective on barriers to repair, as well as the agency and strategies they employ to overcome those barriers. Our research has shown that repairers tend to bypass barriers by means of specific repair techniques and cooperation networks.

ID: 177 | *Extended Abstract*
KEYWORDS: Repair; Circular Economy; Transition; Participatory Design; Grassroots Leadership

Repair as a vehicle for grassroots leadership in transition towards circular economy

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Along with other European countries, the UK produces one of the largest quantities of e-waste per capita in the world. This is driven by excessive consumption and structural problems with recycling, though perhaps also indicates a lack of agency supporting effective personal and community participation in the transition towards circular economy (CE). This transition is predominantly driven by top-down legislation and regulation. CE discourse tends to focus on manufacturing systems and economic prosperity, rather than the social dimension relating to behavioural change, social impacts and implications. This paper reports initial insights from ongoing initiatives by two community regeneration groups to develop localised repair infrastructure in Northeast England. Insights have been gained empirically through a design ethnography approach, and framed in respect of the under-explored social dimension of CE transition. Positive impacts of the project are speculatively presented as rippling outwards through the thematic foci of the repaired object, the repairer, repairers and service users, and wider community. The ongoing inquiry indicates that repairing empowers individuals to take control of their own consumption; creates a locus for collective action and builds community; fosters the exchange of knowledge, skills, tools and time as a fuller spectrum of capitals, demonstrating the importance of bottom-up approaches in transition towards the circular economy.

ID: 230 | *Regular Paper*

KEYWORDS: Repair; Product design; Design education

Designing products that facilitate easy and intuitive repair, an implementation in product design education

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When considering circular economy, reuse, refurbish and repair of products is key in many circular strategies. Both efficient and intuitive disassembly and assembly are crucial facilitators for these strategies, impacting feasibility, cost and economic viability. Thus, product designers and product design educations should focus on how to design products for easy and intuitive disassembly and reassembly to facilitate repairable products. The focus from design educations on these specific processes is however very limited. This paper elaborates on the outcomes of a project-based learning course for design engineering students. The students redesigned an electric device (power tool or household appliance) with special attention to design for repairability strategies. Necessary frameworks and tools were offered to first analyze the disassembly and assembly process of the product and secondly to redesign for repair. Unlike many other methods that are about assessing assembly and disassembly processes in terms of the time needed to perform them, here special attention was paid to the interactions, both cognitive and physical, during repair. This premise aligns better with the context of end-user repair where time is less relevant but where just the interactions need to be easier and more intuitive. Through case studies, it was investigated whether this focus generated valuable results and was feasible to implement. The paper is especially relevant for those concerned with circular product design, the assembly and disassembly of products linked to circular strategies such as repair and the integration within design engineering curricula.

ID: 192 | *Extended Abstract*

KEYWORDS: : Repair; Care; Design; Bereavement; Transformative repair

Transformative repair beyond materiality: care, bereavement and loss

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Intuitively, the practice of repair is an act of care, a service that restores function to products supporting human activities concerned with comfort, pleasure, wellbeing or health. More broadly, repair can be understood as an act of care for the environment, by helping to slow down accumulation of products in landfill or by reducing the need for energy intensive, polluting production of new goods by industry. Repair as an act of care is also emergent in its material practices, as a literally careful form of craft conserving still-functional parts of a broken object, in contrast to conventional 'ground-up' methods of design fabrication from standardised raw materials. In literature there are also examples of repair as an act of care in extended domains, including the social, the communal, the psychological and economic. Within the contemporary context of affluent societies, however, repair as an act of care has its visibility diminished by the easy replaceability of consumer products, impacting the regard for repair in general. Through participatory, practice-based research, we challenge this state of affairs through the concept of transformative repair as an activity improving significance, aesthetics and other values, in addition to function. Evaluating case studies from the project Transformative Repair x JamFactory (2024), we document and assess material transformations with capacity to repair objects connected to emotions, community wellbeing and intangible values of care.

ID: 201 | *Regular Paper*
KEYWORDS: Bedlinen; Home Textiles; Product Expectations; Repair; Circularity

Reviving Bedlinen: User Expectations, Use-Life, and Repair Practices in Australia

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This paper considers the relationship between user expectations of domestic bedlinen, product use-life and repair engagement within an Australian context. Bedlinen, in this instance, includes flat and fitted sheets, pillowcases, and quilt covers - also known as duvet covers, or in Australia, doona covers. There is limited data on this specific textile product within sustainability and circularity research. This paper discusses findings from the survey, Bedlinen and Sustainability (2023), which includes questions focused upon attitudes and behaviour regarding bedlinen purchase, use, care, repair, reuse and disposal. Key findings are identified and are discussed as factors that directly impact the use-life of bedlinen. These include laundering choices, emotional durability, change of mattress sizes, expectations of comfort, maintaining original condition, and repair challenges.

SESSION 36

ID: 226 | *Extended Abstract*

KEYWORDS: Negative Spaces; Fashion Hacking; Zero-Waste Design; Textile Waste; Garment cutting

Re-Imagining Garment Cutting Waste: Fashion Hacking, Zero-Waste, and the Power of Negative Spaces

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This contribution aims to explore the implementation of the zero-waste design approach in fashion, with a specific focus on the offcuts from the cutting stage, here defined as "negative spaces" of both the pattern and the cut garment. The goal is to investigate a new perspective that considers the textile waste generated during the cutting stage as "negative spaces" – "containers" according to the artist Marion Baruch interviewed by Torres (2024) rich in value and meaning – which, instead of being discarded, can be transformed into new textile products for the fashion industry or related sectors. In this context, the designer becomes a "transmuter" of waste, permeating it with economic, social, cultural, and productive value through hacking operations within the design process. Waste material is thus interpreted with a different sensitivity, allowing us to discern "the various visible and invisible components of the cosmos" and to reshape and revalue "the remnants of something we no longer need or want in our lives" (Binotto & Payne, 2016, p.6).

ID: 222 | *Extended Abstract*

KEYWORDS: Design for Circularity; Design for Longevity; Collaborative Design Processes; Circular Uniforms

Circulating History; Design Agency and the case of Museum Uniforms

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The empirical data of this paper will showcase a series of workshops held with management and staff at a museum that ensured ownership of the process and willingness to engage with the development of a circular uniform concept. The paper will further showcase how cultural heritage and historical circular practices stored in museum collections can help inform design for prolonging use phases (Hasling & Ræbild 2017).For this, a workshop toolbox was developed containing 'boundary objects' (Star, 2010), that is, visual and tactile artifacts through which participants can obtain shared understandings in design dialogues for opening what Schön (1983) names 'as-if-worlds' in iterative and abductive processes (Dorst, 2015). Based on this, three workshops were facilitated by the research team. Through a series of workshops, supported by visual and tactile boundary objects, a foundation was established for developing a circular uniform concept that balances economic framework, practical needs, and cultural and organizational identity. This highlights how designers can obtain more agency by being nested thoroughly within an organizational context, and it further showcases how historical textile collections at museums might inform circular design for longevity going forward.

ID: 228 | *Extended Abstract*

KEYWORDS: Modular fashion; Modular design; Sustainable fashion; Longer garment lifetime

Modular Fashion: Sustainable Potential and Challenges for the Industry

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In reimaging the linear fashion system as a circular one, incorporating modularity in fashion design is suggested as a creative and promising possibility. Modular garments and modular fashion (MF) are proposed as interconnected concepts. Modular garments are composed of detachable clothing parts (e.g., collars, sleeves, and main bodies) assembled through clothing closure systems (e.g., zips, buttons and ribbons). MF is a system that integrates modularity across all stages of the garments' lifecycle. Due to the flexible modular structure, MF offers sustainable potential by simplifying repairs (e.g., module replacement) and enabling customisation through mixing and matching detachable parts. Thus, MF is seen as a sustainable strategy that could extend garment longevity and reduce overall consumption by encouraging consumers to consume and dress in a modular manner. Yet, it is unknown how effective MF could be as a sustainable initiative and may affect the fashion industry. This study explores MF's sustainable potential and challenges from an industry perspective. Twelve industry experts are being invited for one-on-one semi-structured interviews; six have been conducted and analysed using thematic analysis via NVivo. Early findings confirm the theoretical sustainable potential of MF but also reveal multiple challenges to its industrial adoption. Challenges fall into three areas: early adopters, the design stage and the production stages, largely due to the inherent complexity of modular design. By exploring the sustainable potential and challenges of MF through industry perspectives, this study extends the existing MF research to an empirical level and points out future directions for MF's further research.

ID: 190 | *Regular Paper*

KEYWORDS: Remake practices; Reuse methods; Fashion remanufacturing; Upcycled garments and accessories; Textile waste

Categorising Remaking Methods for Fashion Practitioners

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Within fashion and textiles, practices which transform existing textile waste materials are discussed using various terms, for example upcycling, remanufacturing, or redesign, however, this study will collectively refer to these as remaking practices. Through the examination of 38 cases of remake collaborations occurring within the Australian community between November 2019 to July 2023, this study explores how the fashion remake outcomes can be classified to more effectively support the development of different remaking practices. As a result, the paper proposes a remaking lexicon to encompass eight different methods which can be employed individually or in combination: over-dye, over-print, embellish, alter, splice, piece, patchwork and refabricate. This proposed categorisation draws parallels to traditional fashion production processes, yet also recognises that end-to-end production skills are not required for remaking, instead showcasing that the methods may use different skillsets. In identifying different types of skills, rather than different levels of skills, this paper highlights an opportunity for remaking practices to engage a wider range of actors and encourage a broader range of specialisations than has been previously suggested. The eight methods provide a clear categorisation to enable more critical comparison and evaluation of remaking practices, encouraging discussion into how the fashion industry might build a diverse ecosystem of remake practitioners.

SESSION 36

ID: 187 | *Regular Paper*
KEYWORDS: Remanufacturing; Circularity; Scaling; Co-Design; Knowledge Exchange

A Shared Vision: The importance of Knowledge Exchange through Co-design in Scaling Circular Strategies for Fashion Remanufacture – Case studies from global perspectives

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Overproduction in the fashion industry poses a significant challenge, leading to excessive resource use and rapidly growing textile waste before garments even reach consumers. The Circular Economy (CE) is gaining recognition as a means to reduce resource consumption through various strategies integrated into product lifecycles. However, effectively scaling these strategies to achieve tangible impacts remains underdeveloped. This paper draws on research projects that collaborate with industry partners to incorporate remanufacturing into existing supply chains. It highlights the essential knowledge exchange required for implementing circular production methods, aiming to identify strategies necessary for scaling. The paper enhances understanding of how remanufacturing pre-consumer textiles can be integrated into large-scale fashion business settings. Through two practice-based research projects, one with a major fashion brand and the other with a large garment factory, the research investigates how co-designing pilot projects as a form of knowledge exchange can facilitate the scaling of circular strategies in fashion production. These projects are designed to be capacity building, enabling the industry partner to develop systems that can expand the implementation of remanufacturing excess stock. While extensive research exists on circular strategies, there is limited understanding of practical implementation and how collaborations between research and industry can foster a knowledge exchange that supports the transition to circularity. The implementation of remanufacturing, like other circular strategies, depends on adapting processes contextually with a clear understanding of industry's existing parameters and developing design responses that can effectively maintain value and recirculate garment stock.

FRIDAY ROOM 5.127