

Review

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Review

Investigating the Limitations of Fashion Research Methods in Applying a Sustainable Design Practice: A Systematic Review

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Investigating the limitations of fashion research methods in applying a sustainable design practice: a systematic review

Abstract: The need of research is often a complex issue. The standardization of methodologies, deeply rooted in the scientific method, has allowed humanity to progress. Since the fashion industry represents one of the most problematic industries globally, it is paramount to investigate the handicaps of fashion research practice. The goal of this systematic review is to outline the most used methodologies in the fashion research field that are being explored to achieve sustainability goals. The findings highlight the fragmentation of the literature in fashion research methodologies in relation to sustainability. Interviews and case studies are the most used methods while other less conventional, like Social Life Cycle Assessment, have been also tried. Finally, it is tested how ChatGPT can discuss and inform future routes to incorporate the findings. Together, this work reveals the handicaps of the fashion research methodologies and show an example on how ChatGPT can be assessed to help the fashion practitioners define research plans to achieve sustainable goals.

Keywords: fashion research; sustainable fashion design; fashion research methods; sustainable design; ChatGPT

Introduction

"The saddest aspect of life right now is that science gathers knowledge faster than society gathers wisdom." Isaac Asimov

The fashion industry's worldwide apparel and footwear market size forecast for 2023 is almost 2 trillion dollars, representing a 6% growth for the period 2022-2023 (<https://fashionunited.com/companies/euromonitor-international>, consulted on May 29, 2023). However, the trend is to decrease its growth for the post-pandemic period, where it rescued the 18% loss. Still, the fashion industry faces numerous challenges, from the environmental cost of manufacturing (Bick et al., 2018; Pal and Gander, 2018), to the social issues (Bick et al., 2018; Adamkiewicz et al., 2022), and the economic unpredictable shifts (Hernandez and Haddud, 2018; Nikosey, 2020; Castaneda-Navarrete et al., 2021). These combined factors represent a global environmental justice dilemma supplemented with strong economic risks with no clear solution foreseen (Pedersen et al., 2018; Brydges et al., 2020; Galanakis et al., 2022).

Humankind has been using a manyfold of research approaches to explore, comprehend, develop, and test solutions for its own progress (Williams, 2007). Despite the fact that the pace of producing data (<https://explodingtopics.com/blog/data-generated-per-day>, consulted on May 29,

2023) and the specialization degree of experts (Young and Muller, 2015) has been increasing, there is a need for a better understanding of the long-term impact of human activities (Mensah, 2019).

During the recent years the lack of circularity of the fashion industry has gathered interest from the mainstream media with brands like H&M and Zara finding themselves under huge scrutiny (Dragomir and Dumitru, 2022). Such attention is paving the way for the improvement of the consumers' sustainable and more ethical buying behaviour.

Ultimately the climate crisis is a complex issue to be solved by efforts coming from many disciplines of knowledge and stakeholders, and therefore it is necessary to foster an enhanced research practice with standardized methodologies able to generate results that could be compared and widely replicable. To cite a wicked example, a broadly cited paper recently published in Nature Reviews Earth & Environment by Niinimäki and colleagues about the environmental impacts of the global clothing system used a reasonable amount of grey literature, presenting questionable methods and some contradictory estimations (Niinimäki et al., 2020). So, there is an urgent need to improve the field of fashion research by increasing the criticality of the field. Only a combined effort at a global level can represent an example and force a multitude of progressive actions towards the resolution of the current and, perhaps, upcoming crises. Therefore, this systematic review aims to critically analyse the most relevant fashion research methodologies published during the period ranging from 2015 and 2023 and delineate guidance considerations.

Methodology

The systematic approach method here used was adapted from the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) method (Page et al., 2021). The method consists of a checklist composed of 27 items and a flow diagram that guides the reporting of systematic reviews based on transparency, accuracy, and comprehensiveness. So PRISMA 2020 is used for clear and complete identification of the relevant literature under the objective of answering the research question: how has fashion research methodologies being implemented to achieve sustainable goals?

Identified studies

For the purpose of this study the records were identified through Scopus databases (Table 1). For the identification phase, a different combination of appropriate keywords was searched using "AND" or "OR" whenever applicable in the database. The first search on Scopus used the combination "fashion research" AND "fashion design" AND "sustainability", resulting in 29,825 articles. The second search on Scopus used the combination "fashion research" AND "fashion design" AND "sustainability" AND ("methods" OR "methodology" OR "methodologies") and was limited to Business, Management and Accounting, and Environmental Science, resulting in 7,351 articles. Finally, the third search used the combination "fashion research" AND "fashion design" AND "sustainability" AND ("methods" OR "methodology" OR "methodologies") AND ("limitations" OR "challenges") AND "fashion industry" AND "environmental impact" AND "fashion research methods", limited to the same fields, resulting in 3,144 articles. All searches found in Scopus were limited to Research Articles and Case Reports published between the years 2015 and 2023. Only Open access & Open archive were considered resulting in a total of 656 articles (Table 1).

Table 1. Research methodology description.

Identification criterion	Description
Research objective	Investigate the impact of fashion research methodologies in sustainable design practice
Database	Scopus, assessed on April 15 th 2023
Article types	Research articles, Case reports
Keywords	Fashion research, sustainability, methods, methodology, methodologies, limitations, challenges, fashion industry, environmental impact, fashion research methods
Language	English
Research criteria	Based on 3 research criteria: (1) ‘fashion research’ and ‘fashion design’ and ‘sustainability’, (2) ‘fashion research and ‘fashion design’ and ‘sustainability’ and ‘methods’ or ‘methodology’ or ‘methodologies’ and limited to the subject areas ‘Business, Management and Accounting’ and ‘Environmental Science’, (3) ‘fashion research and ‘fashion design’ and ‘sustainability’ and ‘methods’ or ‘methodology’ or ‘methodologies’ and ‘limitations’ or ‘challenges’ and ‘fashion industry and ‘environmental impact’ and ‘fashion research methods’ and limited to the same subject areas.
Research years	2015–2023

Screened studies

In order to filter the retrieved papers, their titles and abstracts were assessed to check the relevance for the research objective. From the initial 656 entries, a total of 49 were selected for relevance in answering the research question under analysis. A total number of 607 entries were excluded from the records identified throughout the databases for the following reasons: not aligned with the research objective (n = 511), no relevant outcome, or not focused on fashion (n = 50), literature review-based articles or perspectives (n = 24), focus on COVID-19 pandemic (n = 17), and potential conflict of interests or bias (n = 5).

Analyses of studies and bias

Since the entries were filtered manually there is a potential risk of bias or exclusion of relevant papers. However, since the PRISMA 2020 method was applied this risk is considered throughout the study and the results and discussion presented must be interpreted as potentially relevant but not final (Supplemental material 1). One important thing to be considered is the fragmentation of the literature in the scope here studied. Such fragmentation increases the challenge of reporting, comprehending, and comparing between research projects and increase difficulties of further studies, not to mention the potential limitation of implementation and replication of the results in the field. Thus, the transfer of results and knowledge may be hindered. For the purpose of this study literature reviews included as part of the selected and screened studies were neglected since they do not represent truly experimental and verifiable approaches.

Results

The starting scope of this research was intended to span a longer timeline to take into account initiatives about fashion design methodologies tackling sustainable challenges happening earlier than 2015. However, the high number of entries retrieved by the database in the recent years revealed that a strong interest in the sustainable aspect of fashion design and fashion industry is huge and presenting an increasing trend, despite the fragmented and unclear approaches documented.

In regard to the methods implemented and described by the analysed entries, the most used research methods was interviews (n = 13), surveys (n = 11), and life cycle assessments (LCA) (n = 7). There were several research methods only used by one study, such as adaptive choice-based conjoint analysis, focus groups, and the two-round disaggregative Delphi approach (Table 2). Despite the recent interest in biodesign and related subareas (*e.g.*, biofabrication (Moroni *et al.*, 2018)), there was no screened study that explored those areas.

Table 2. Total number of studies per type of method with the respective references.

Type of method (n = total)			Reference
Adaptive choice-Based conjoint analysis (n = 1)			Fuchs and Hovemann, 2022
			Camacho-Otero et al., 2019; Brydges, 2021; Pal et al., 2021;
Case study (n = 10)			Cooper and Claxton, 2022; Dragomir and Dumitru, 2022;
			Gossen and Kropfeld, 2022; Salmi and Kaipia, 2022; Valor et al., 2022; Garcia-Ortega et al., 2023; López et al., 2023
Compositional analysis (n = 1)			Wesley et al., 2023
Focus group (n = 1)			Aydin et al., 2023
Framework development/ Theoretical model (n = 5)			Turunen and Halme, 2021; Shou et al., 2022; Aydin et al.,
			2023; Kautish et al., 2023; Shamsuzzaman et al., 2023

Index Decomposition Analysis through	
the Logarithmic mean divisia index,	Román-Collado et al., 2023
and decoupling analysis (n = 1)	
Interactive action research (n = 1)	Sandberg, 2023
	Padilha and Gomes, 2016; Singh et al., 2019; Fontana et al.,
	2021; Gossen and Heinrich, 2021; Sandberg and Hultberg,
	2021; Siderius et al., 2021; Bocken and Konietzko, 2022;
Interview (n = 13)	Laukkanen and Tura, 2022; Nayak et al., 2022; Amasawa et
	al., 2023; Dukovska-Poposka et al., 2023; Persson and
	Hinton, 2023; Shamsuzzaman et al., 2023
	Stone et al., 2020; Martin and Herlaar, 2021; Angelis-
LCA (n = 7)	Dimakis et al., 2022; Mölsä et al., 2022; Shou et al., 2022;
	Amasawa et al., 2023; Wesley et al., 2023
Material flow analysis (n = 1)	Schmutz and Som, 2022
Material flow analysis and carbon cost	
analysis (n = 1)	Millward-Hopkins et al., 2023
Mathematical approach (n = 1)	Peters et al., 2021
Scanning electron microscopy (n = 1)	Wesley et al., 2023
Scenario development (n= 2)	Repp et al., 2021; Shou et al., 2022
Social LCA (n = 1)	Martin and Herlaar, 2021
Stakeholder analysis (n = 1)	Singh et al., 2019
	Dhir et al., 2021; Bhandari et al., 2022; Dangelico et al., 2022;
	de Oliveira et al., 2022; Fuchs and Hovemann, 2022;
Survey (n = 11)	Johnstone and Lindh, 2022; Schmutz and Som, 2022; Xue et
	al., 2022; Amasawa et al., 2023; Pandey and Yadav, 2023;
	Scott et al., 2023

Systematic analysis (n = 2)	Jain et al., 2021; Cooper and Claxton, 2022
Systems model technique (Causal loop diagram (n = 1)	Singh et al., 2019
Thematic analysis (n = 1)	Bocken and Konietzko, 2022
Thermal transformation of waste cotton textile into carbon fibre (n = 1)	Wesley et al., 2023
Thermo-gravimetric analysis (n = 1)	Wesley et al., 2023
Two-round disaggregative Delphi approach (n = 1)	Louma et al., 2022
X-ray diffraction (n = 1)	Wesley et al., 2023

In terms of the limitations found during this study, they can be summarized in:

- Low number of participants/objects under study, limited geographies included (namely one country or in the same region), and limited range of time of the participation (Padilha and Gomes, 2016; Camacho-Otero et al., 2019; Brydges, 2021; Dhir et al., 2021; Fontana et al., 2021; Gossen and Heinrich, 2021; Sandberg and Hultberg, 2021; Siderius et al., 2021; Turunen and Halme, 2021; Bocken and Konietzko, 2022; Bhandari et al., 2022; Dangelico et al., 2022; de Oliveira et al., 2022; Fuchs and Hovemann, 2022; Gossen and Kropfeld, 2022; Louma et al., 2022; Nayak et al., 2022; Salmi and Kaipia, 2022; Valor et al., 2022; Xue et al., 2022; Aydin et al., 2023; Garcia-Ortega et al., 2023; Kautish et al., 2023; Román-Collado et al., 2023; Pandey and Yadav, 2023; Scott et al., 2023; Shamsuzzaman et al., 2023).
- Limited knowledge and few technological tools from and for the stakeholders to enhance sustainability and/or collaborative actions (Repp et al., 2021; Pal et al., 2021; Siderius et al., 2021; Cooper and Claxton, 2022; Bhandari et al., 2022; Dragomir and Dumitru, 2022; Fuchs and Hovemann, 2022; Gossen and Kropfeld, 2022; Laukkanen and Tura, 2022; Louma et al., 2022; Nayak et al., 2022; Shou et al., 2022; Valor et al., 2022; Kautish et al., 2023; López et al., 2023; Millward-Hopkins et al., 2023; Román-Collado et al., 2023).
- Limited scope of the developed method (Padilha and Gomes, 2016; Dhir et al., 2021; Repp et al., 2021; Martin and Herlaar, 2021; Turunen and Halme, 2021; Angelis-Dimakis et al., 2022; Bhandari et al., 2022; Bocken and Konietzko, 2022; Dragomir and Dumitru, 2022; Fuchs and Hovemann, 2022; Laukkanen and Tura, 2022; Mölsä et al., 2022; Schmutz and Som, 2022; Shou et al., 2022; Valor et al., 2022; Aydin et al., 2023; Kautish et al., 2023; López et al., 2023; Millward-Hopkins et al., 2023; Sandberg, 2023; Scott et al., 2023; Shamsuzzaman et al., 2023).

There was also observed that no discussion was presented regarding the particular method limitations (Jain et al., 2021; Johnstone and Lindh, 2022; Stone et al., 2020; Persson and Hinton, 2023; Schmutz and Som, 2022; Wesley et al., 2023).

All the limitations summarized above were highlighted by the respective authors which means that there is a chance of an underrepresentation of the limitations of particular methods. This is exemplified by Bocken and Konietzko (2022) since the authors assumed the replicability limitation of their interviewing methodology which was not assumed by the other researchers who also perform interviews. The same occurred with surveys (Dhir *et al.*, 2021).

Discussion using ChatGPT¹

First round

Prompt by the author

- Tell me what are the main challenges for fashion design research in terms of the global sustainability goals?

Reply from ChatGPT

Fashion design research faces several challenges in terms of achieving the global sustainability goals. Here are some of the main challenges:

(1) Material Selection

Finding sustainable and eco-friendly materials is a significant challenge. Many traditional materials used in fashion, such as polyester and conventional cotton, have a high environmental impact due to their production processes and use of harmful chemicals. Researching and developing alternative materials that are biodegradable, recycled, or derived from renewable sources is crucial.

(2) Supply Chain Transparency

Ensuring transparency and traceability throughout the fashion supply chain is a complex task. It involves understanding the origins of raw materials, manufacturing processes, and the environmental and social impacts associated with each stage. Fashion design research must focus on developing tools, technologies, and standards that enable brands to track their supply chains effectively and make informed sustainable decisions.

(3) Waste Management

Addressing the issue of textile waste is a significant challenge. The fashion industry generates a substantial amount of waste through production cut-offs, unsold inventory, and discarded garments. Design research should focus on developing innovative techniques for recycling, upcycling, and repurposing textile waste, as well as exploring circular economy models that minimize waste generation.

(4) Consumer Behaviour

Shifting consumer behaviour towards more sustainable choices presents a challenge. Fashion design research needs to understand consumer attitudes, preferences, and motivations to develop products that align with sustainable values. Educating consumers about the environmental and social impacts of their fashion choices is essential to encourage more responsible consumption patterns.

(5) Collaboration and Industry Transformation

Achieving sustainability goals requires collaboration among various stakeholders, including designers, manufacturers, policymakers, and consumers. Fashion design research needs to foster interdisciplinary collaboration and facilitate knowledge sharing to drive industry-wide transformation. This includes engaging with policymakers to create supportive regulations and standards that promote sustainable practices.

(6) Scaling Sustainable Solutions

While there are many innovative and sustainable fashion solutions, scaling them up to an industry-wide level remains a challenge. Research needs to focus on developing scalable technologies, production methods, and business models that can be adopted by fashion brands across the globe. This involves considering factors like cost, scalability, and compatibility with existing industry infrastructure.

¹ ChatGPT, personal communication, May 26-30, 2023

(7) Longevity and Timelessness

Fast fashion, with its focus on disposable and short-lived trends, contributes to environmental degradation. Fashion design research needs to explore concepts like durability, longevity, and timelessness in garment design. Creating timeless designs and encouraging the use of quality materials can contribute to reducing the environmental impact associated with frequent fashion consumption.

By addressing these challenges, fashion design research can play a vital role in driving the industry towards more sustainable practices and achieving the global sustainability goals.

Prompt by the author

- Based on those seven points may you define a research methodological framework based on a blend of the scientific method and creativity methods in order to test the feasibility of potential solutions?

Reply from ChatGPT

Certainly! Here's a research methodological framework that combines elements of the scientific method and creativity methods to test the feasibility of potential solutions for sustainable fashion design:

(1) Problem Identification and Research Question

- Clearly define the problem or challenge related to sustainable fashion design.
- Formulate a research question that guides your investigation.

(2) Literature Review

- Conduct a comprehensive review of existing literature and research related to sustainable fashion design, materials, supply chains, waste management, consumer behaviour, collaboration, and industry transformation.
- Identify gaps and areas that require further exploration.

(3) Hypothesis Generation

- Based on the literature review, generate hypotheses or potential solutions that address the identified challenges.
- These hypotheses should propose innovative and sustainable approaches to the problem.

(4) Data Collection

- Design and implement data collection methods that align with your research question and hypotheses.
- This may involve qualitative methods such as interviews, focus groups, and observations, as well as quantitative methods like surveys and data analysis.

(5) Idea Generation and Ideation

- Utilize creative methods and ideation techniques, such as brainstorming sessions, design thinking workshops, or participatory design, to generate a wide range of potential solutions.
- Encourage diverse perspectives and collaboration among stakeholders to foster creativity.

(6) Prototyping and Testing

- Select a subset of the generated ideas and develop prototypes or minimum viable products (MVPs) that represent the potential solutions.
- Test the prototypes in controlled environments or real-life scenarios to assess their feasibility, functionality, and sustainability performance.

- Gather feedback from users, experts, and other relevant stakeholders to refine the prototypes.

(7) Evaluation and Analysis

- Analyse the data collected from testing and prototype evaluation.
- Assess the potential solutions based on predefined criteria, such as environmental impact, social implications, economic viability, scalability, and compatibility with industry practices.
- Use statistical analysis, qualitative analysis, or a combination of both to draw meaningful conclusions.

(8) Iteration and Refinement

- Based on the evaluation results, refine and iterate on the potential solutions.
- Modify the prototypes or generate new ideas if necessary.
- Repeat the testing and evaluation process to continuously improve and validate the feasibility of the solutions.

(9) Documentation and Reporting

- Document the research methodology, data collection process, results, and conclusions.
- Communicate findings through research papers, reports, presentations, or other appropriate mediums.
- Share insights with the academic community, industry professionals, policymakers, and other relevant stakeholders.

By integrating elements of the scientific method (hypothesis generation, data collection, evaluation) with creativity methods (idea generation, prototyping, iteration), this framework allows for a systematic and rigorous approach to testing the feasibility of potential solutions in sustainable fashion design research.

Second round

Prompt by the author

- Now assume you are a decision-maker with full powers in your region, country and continent. You also have influence globally. You were asked to develop a research plan to create and validate a framework for fashion practitioners (designers and professionals in companies) to fully transform the field. You have control on the budget to perform the project and to hire the necessary people to help you throughout the process. The brief is the following: 1) timeline of 3 years; 2) the outcomes of the project must be easily actionable across the fashion industry, despite further necessary adaptations and particular validations and optimizations; 3) take into consideration the following handicaps of current methodologies: i) Low number of participants/objects under study, limited geographies included (namely one country or in the same region), and limited range of time of the participation, ii) Limited knowledge and technological tools from and for the stakeholders to enhance sustainability and/or collaborative actions, and iii) Limited scope of the developed methodology. Now please develop the research plan in less than 1000 words.

Reply from ChatGPT

Research Plan:

Developing a Transformative Framework for Sustainable Fashion Design

Objective:

The objective of this research plan is to develop and validate a transformative framework for fashion practitioners (designers and professionals in companies) that can drive sustainable practices across the fashion industry. The framework should be easily actionable, adaptable to different contexts, and capable of addressing the handicaps of current methodologies.

Timeline:

The research plan will span a period of three years, structured into the following phases:

Year 1: Preparatory Phase

- Assemble a multidisciplinary research team consisting of experts in sustainable fashion, design, supply chain management, consumer behaviour, and technology.
- Conduct an extensive literature review to gather existing knowledge on sustainable fashion practices, methodologies, and frameworks.
- Identify and engage with key stakeholders in the fashion industry, including designers, manufacturers, policymakers, and NGOs, to understand their challenges, needs, and perspectives.

Year 2: Framework Development Phase

- Design and implement a large-scale global research study that overcomes the handicaps of current methodologies:
- Ensure a diverse and representative participant pool from various countries and regions, involving designers, professionals, and other stakeholders from different fashion sectors.
- Employ advanced technology tools, such as data analytics, machine learning, and blockchain, to enhance sustainability and collaborative actions within the study.
- Develop an expansive and adaptable methodology that encompasses different geographies, cultures, and timeframes to capture a comprehensive understanding of sustainable fashion practices.
- Collect data through mixed methods, including surveys, interviews, observations, and industry case studies, to generate rich insights into sustainable fashion practices, challenges, and opportunities.
- Apply iterative and participatory design processes, involving stakeholders in co-creation sessions to refine and validate the framework's components.
- Continuously assess the feasibility and practicality of the framework to ensure its actionability and adaptability across the fashion industry.

Year 3: Validation and Dissemination Phase

- Validate the framework through pilot implementations in collaboration with selected fashion companies and organizations.
- Assess the impact of implementing the framework on sustainability performance, consumer behavior, supply chain transparency, and collaboration within the participating organizations.
- Gather feedback from practitioners and stakeholders involved in the pilot implementations to refine and optimize the framework.
- Develop practical guidelines, toolkits, and training materials that distill the framework's key principles and actionable steps for easy adoption across the fashion industry.
- Disseminate the research findings, framework, and associated resources through publications, industry conferences, workshops, and online platforms.
- Collaborate with global fashion associations, NGOs, and policymakers to advocate for the adoption of the framework and support its implementation at a broader scale.

Budget and Resource Allocation:

Allocate a substantial budget to support the research plan, including funding for the research team, data collection tools, technology infrastructure, participant recruitment, pilot implementations, and dissemination activities. Establish partnerships with academic institutions, industry sponsors, and funding agencies to secure additional financial resources.

Hire a diverse and skilled research team comprising sustainable fashion experts, data analysts, design researchers, and project managers. Collaborate with external consultants, industry professionals, and stakeholders to ensure comprehensive expertise and perspectives throughout the research plan.

Conclusion:

This research plan outlines a comprehensive three-year timeline for developing and validating a transformative framework for sustainable fashion design. By addressing the handicaps of current methodologies, leveraging advanced technologies, and involving global stakeholders, the resulting framework will be actionable, adaptable, and capable of driving sustainability practices across the fashion industry.

Conclusions

This study evidences the non-trivial nature of researching within the fashion discipline. Despite the methodological arsenal social sciences provide to fashion research (*e.g.*, surveys, case studies) and the increasing use of more quantitative approaches (*e.g.*, circular economy metrics and LCA) the common goal is to improve the fashion practice in terms of its current sustainability handicaps. The scientific viewpoints highlighted during this study are manifold. So, it is not easy to standardize the frameworks to help the decision-making. As more quantitative approaches are implemented the need of adding different competencies to the fashion design practice is becoming apparent.. As conclusion it is suggested that a broad network of universities, companies, not-for-profit organizations, alongside informed citizens combine their interests and expertise to co-design and validate a powerful set of methodologies for fashion research purposes such as seen in order initiatives like the BoSS (<https://cordis.europa.eu/project/id/101079995>), EUROWEB (<https://euroweb.uw.edu.pl>), CONTEXT (<https://www.context-cost.eu>), REFREAM (<https://cordis.europa.eu/project/id/825647>), CORENET (<https://cordis.europa.eu/project/id/260169>), and MICRO-DRESS (<https://cordis.europa.eu/project/id/260113>) European funded projects (happening mandatory consortia).

Finally, this study may be helpful for policy making since it uncovers the handicaps of performing relevant research in the realm of fashion design and fashion industry focusing a more sustainable practice, supplemented with a prototype guidance from ChatGPT to allow a fast and reliable discourse under the scope of the objective of this study.

Supplementary Materials: The following supporting information can be downloaded at the website of this paper posted on Preprints.org.

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Declaration of Generative AI and AI-assisted technologies in the writing process: During the preparation of this work the author used ChatGPT in order to add a contribution to the discussion based on a broad AI-based answers to two questions related to the areas and research methodologies to be explored in fashion-related studies to achieve sustainability. After using this tool, the author reviewed the content but chose to leave it not edited. Still, the author takes full responsibility for the content of this publication.

References

- Adamkiewicz, J., Kochańska, E., Adamkiewicz, I., and Łukasik, R. M. (2022). "Greenwashing and sustainable fashion industry". *Current Opinion in Green and Sustainable Chemistry*, 38, 100710. <https://doi.org/10.1016/j.cogsc.2022.100710>
- Amasawa, E., Brydges, T., Henninger, C. E., and Kimita, K. (2023). "Can rental platforms contribute to more sustainable fashion consumption? Evidence from a mixed-method study". *Cleaner and Responsible Consumption*, 8, 100103. <https://doi.org/10.1016/j.clrc.2023.100103>

- Angelis-Dimakis, A., Whitehouse, A., Vyrkou, A., Hebden, A., Rana, S., and Goswami, P. (2022). "Life cycle environmental impact and economic assessment of British Wool face masks". *Cleaner Environmental Systems*, 6, 100084. <https://doi.org/10.1016/j.cesys.2022.100084>
- Aydin, N., Seker, S., Devenci, M., Ding, W., and Delen, D. (2023). "A linear programming-based QFD methodology under fuzzy environment to develop sustainable policies in apparel retailing industry". *Journal of Cleaner Production*, 387, 135887. <https://doi.org/10.1016/j.jclepro.2023.135887>
- Bhandari, N., Garza-Reyes, J. A., Rocha-Lona, L., Kumar, A., Naz, F., and Joshi, R. (2022). "Barriers to sustainable sourcing in the apparel and fashion luxury industry". *Sustainable Production and Consumption*, 31, 220-235. <https://doi.org/10.1016/j.spc.2022.02.007>
- Bick, R., Halsey, E., and Ekenga, C. C. (2018). "The global environmental injustice of fast fashion". *Environmental Health*, 17, 1-4. <https://doi.org/10.1186/s12940-018-0433-7>
- Bocken, N., and Konietzko, J. (2022). "Circular business model innovation in consumer-facing corporations". *Technological Forecasting and Social Change*, 185, 122076. <https://doi.org/10.1016/j.techfore.2022.122076>
- Brydges, T. (2021). "Closing the loop on take, make, waste: Investigating circular economy practices in the Swedish fashion industry". *Journal of Cleaner Production*, 293, 126245. <https://doi.org/10.1016/j.jclepro.2021.126245>
- Brydges, T., Retamal, M., and Hanlon, M. (2020). "Will COVID-19 support the transition to a more sustainable fashion industry?". *Sustainability: Science, Practice and Policy*, 16(1), 298-308. <https://doi.org/10.1080/15487733.2020.1829848>
- Camacho-Otero, J., Boks, C., and Pettersen, I. N. (2019). "User acceptance and adoption of circular offerings in the fashion sector: Insights from user-generated online reviews". *Journal of Cleaner Production*, 231, 928-939. <https://doi.org/10.1016/j.jclepro.2019.05.162>
- Castañeda-Navarrete, J., Hauge, J., and López-Gómez, C. (2021). "COVID-19's impacts on global value chains, as seen in the apparel industry". *Development Policy Review*, 39(6), 953-970.
- Cooper, T., and Claxton, S. (2022). "Garment failure causes and solutions: Slowing the cycles for circular fashion". *Journal of Cleaner Production*, 351, 131394.
- Cooper, T., Claxton, S., Hill, H., Holbrook, K., Hughes, M., Knox, A., and Oxborrow, L. (2013). "Development of an Industry Protocol on Clothing Longevity". *Report Produced for Waste and Resources Action Programme (WRAP)*. Nottingham: Trent University Nottingham.
- Dangelico, R. M., Alvino, L., and Fraccascia, L. (2022). "Investigating the antecedents of consumer behavioral intention for sustainable fashion products: Evidence from a large survey of Italian consumers". *Technological Forecasting and Social Change*, 185, 122010.
- de Oliveira, L. G., Miranda, F. G., and de Paula Dias, M. A. (2022). "Sustainable practices in slow and fast fashion stores: What does the customer perceive?". *Cleaner Engineering and Technology*, 6, 100413.
- Dhir, A., Sadiq, M., Talwar, S., Sakashita, M., and Kaur, P. (2021). "Why do retail consumers buy green apparel? A knowledge-attitude-behaviour-context perspective". *Journal of Retailing and Consumer Services*, 59, 102398.
- Dragomir, V. D., and Dumitru, M. (2022). "Practical solutions for circular business models in the fashion industry". *Cleaner Logistics and Supply Chain*, 4, 100040.
- Dukovska-Popovska, I., Ivert, L. K., Jónsdóttir, H., Dreyer, H. C., and Kaipia, R. (2023). "The supply and demand balance of recyclable textiles in the Nordic countries". *Waste Management*, 159, 154-162.
- Fierro Hernandez, D., and Haddud, A. (2018). "Value creation via supply chain risk management in global fashion organizations outsourcing production to China". *Journal of Global Operations and Strategic Sourcing*, 11(2), 250-272.
- Fontana, E., Öberg, C., and Poblete, L. (2021). "Nominated procurement and the indirect control of nominated sub-suppliers: Evidence from the Sri Lankan apparel supply chain". *Journal of Business Research*, 127, 179-192.
- Fuchs, M., and Hovemann, G. (2022). "Consumer preferences for circular outdoor sporting goods: An Adaptive Choice-Based Conjoint analysis among residents of European outdoor markets". *Cleaner Engineering and Technology*, 11, 100556.
- Galanakis, C. M., Brunori, G., Chiaramonti, D., Matthews, R., Panoutsou, C., and Fritsche, U. R. (2022). "Bioeconomy and green recovery in a post-COVID-19 era". *Science of The Total Environment*, 808, 152180.
- Garcia-Ortega, B., Galan-Cubillo, J., Llorens-Montes, F. J., and de-Miguel-Molina, B. (2023). "Sufficient consumption as a missing link toward sustainability: The case of fast fashion". *Journal of Cleaner Production*, 399, 136678.
- Gossen, M., and Heinrich, A. (2021). "Encouraging consumption reduction: Findings of a qualitative study with clothing companies on sufficiency-promoting communication". *Cleaner and Responsible Consumption*, 3, 100028.

- Gossen, M., and Kropfeld, M. I. (2022). "'Choose nature. Buy less.' Exploring sufficiency-oriented marketing and consumption practices in the outdoor industry". *Sustainable Production and Consumption*, 30, 720-736.
- Jain, V., O'Brien, W., and Gloria, T. P. (2021). "Improved solutions for shared value creation and maximization from used clothes: Streamlined structure of clothing consumption system and a framework of closed loop hybrid business model". *Cleaner and Responsible Consumption*, 3, 100039.
- Johnstone, L., and Lindh, C. (2022). "Sustainably sustaining (online) fashion consumption: Using influencers to promote sustainable (un) planned behaviour in Europe's millennials". *Journal of Retailing and Consumer Services*, 64, 102775.
- Kautish, P., Purohit, S., Filieri, R., and Dwivedi, Y. K. (2023). "Examining the role of consumer motivations to use voice assistants for fashion shopping: The mediating role of awe experience and eWOM". *Technological Forecasting and Social Change*, 190, 122407.
- Laukkanen, M., and Tura, N. (2022). "Sustainable value propositions and customer perceived value: Clothing library case". *Journal of Cleaner Production*, 378, 134321.
- López, B., Rangel-Pérez, C., and Fernández, M. (2023). "Sustainable strategies in the luxury business to increase efficiency in reducing carbon footprint". *Journal of Business Research*, 157, 113607.
- Luoma, P., Penttinen, E., Tapio, P., and Toppinen, A. (2022). "Future images of data in circular economy for textiles". *Technological Forecasting and Social Change*, 182, 121859.
- Martin, M., and Herlaar, S. (2021). "Environmental and social performance of valorizing waste wool for sweater production". *Sustainable Production and Consumption*, 25, 425-438.
- Mensah, J. (2019). "Sustainable development: Meaning, history, principles, pillars, and implications for human action: Literature review". *Cogent social sciences*, 5(1), 1653531.
- Millward-Hopkins, J., Purnell, P., and Baurley, S. (2023). "A material flow analysis of the UK clothing economy". *Journal of Cleaner Production*, 407, 137158.
- Mölsä, K. M., Horn, S., Dahlbo, H., and Rissanen, M. (2022). "Linear, reuse or recycling? An environmental comparison of different life cycle options for cotton roller towels". *Journal of Cleaner Production*, 374, 133976.
- Moroni, L., Boland, T., Burdick, J. A., De Maria, C., Derby, B., Forgacs, G., ... and Vozzi, G. (2018). "Biofabrication: a guide to technology and terminology". *Trends in biotechnology*, 36(4), 384-402. <https://doi.org/10.1016/j.tibtech.2017.10.015>
- Munasinghe, P., Druckman, A., and Dissanayake, D. G. K. (2021). "A systematic review of the life cycle inventory of clothing". *Journal of Cleaner Production*, 320, 128852.
- Nayak, R., George, M., Haq, I. U., and Pham, H. C. (2022). "Sustainability benefits of RFID technology in Vietnamese fashion supply chain". *Cleaner Logistics and Supply Chain*, 5, 100086.
- Niinimäki, K., Peters, G., Dahlbo, H., Perry, P., Rissanen, T., and Gwilt, A. (2020). "The environmental price of fast fashion". *Nature Reviews Earth & Environment*, 1(4), 189-200.
- Nikosey, D. (2020). "Mitigating Global Supply Chain Risk in the Fashion Industry".
- Padilha, C. K., and Gomes, G. (2016). "Innovation culture and performance in innovation of products and processes: a study in companies of textile industry". *RAI Revista de Administração e Inovação*, 13(4), 285-294.
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... and Moher, D. (2021). "The PRISMA 2020 statement: an updated guideline for reporting systematic reviews". *International journal of surgery*, 88, 105906.
- Pal, R., and Gander, J. (2018). "Modelling environmental value: An examination of sustainable business models within the fashion industry". *Journal of cleaner production*, 184, 251-263.
- Pal, R., Samie, Y., and Chizaryfard, A. (2021). "Demystifying process-level scalability challenges in fashion remanufacturing: An interdependence perspective". *Journal of Cleaner Production*, 286, 125498.
- Pandey, M., and Yadav, P. S. (2023). "Understanding the role of individual concerns, attitude, and perceived value in green apparel purchase intention; the mediating effect of consumer involvement and moderating role of generation Z&Y". *Cleaner and Responsible Consumption*, 9, 100120.
- Pedersen, E. R. G., Gwozdz, W., and Hvass, K. K. (2018). "Exploring the relationship between business model innovation, corporate sustainability, and organisational values within the fashion industry". *Journal of business ethics*, 149, 267-284.
- Persson, O., and Hinton, J. B. (2023). "Second-hand clothing markets and a just circular economy? Exploring the role of business forms and profit". *Journal of Cleaner Production*, 390, 136139.
- Peters, G., Li, M., and Lenzen, M. (2021). "The need to decelerate fast fashion in a hot climate-A global sustainability perspective on the garment industry". *Journal of cleaner production*, 295, 126390.
- Repp, L., Hekkert, M., and Kirchherr, J. (2021). "Circular economy-induced global employment shifts in apparel value chains: Job reduction in apparel production activities, job growth in reuse and recycling activities". *Resources, conservation and recycling*, 171, 105621.
- Román-Collado, R., Sanz-Díaz, M. T., and Blanco, L. Y. (2023). "Key drivers of the textile and clothing industry decarbonisation within the EU-27". *Journal of Environmental Management*, 334, 117438.
- Salmi, A., and Kaipia, R. (2022). "Implementing circular business models in the textile and clothing industry". *Journal of Cleaner Production*, 378, 134492.

- Sandberg, E. (2023). "Orchestration capabilities in circular supply chains of post-consumer used clothes—A case study of a Swedish fashion retailer". *Journal of Cleaner Production*, 135935.
- Sandberg, E., and Hultberg, E. (2021). "Dynamic capabilities for the scaling of circular business model initiatives in the fashion industry". *Journal of Cleaner Production*, 320, 128831.
- Schmutz, M., and Som, C. (2022). "Identifying the potential for circularity of industrial textile waste generated within Swiss companies". *Resources, Conservation and Recycling*, 182, 106132.
- Scott, E. L., Bhamra, T., Mohammed, M. I., and Johnson, A. A. (2023). "Investigating knitwear product development in small and medium enterprises: A report of practices related to environmental sustainability". *Cleaner Logistics and Supply Chain*, 7, 100105.
- Shamsuzzaman, M., Islam, M. M., Hasan, H. R. U., Khan, A. M., and Sayem, A. S. M. (2023). "Mapping environmental sustainability of knitted textile production facilities". *Journal of Cleaner Production*, 405, 136900.
- Shou, M., and Domenech, T. (2022). "Integrating LCA and blockchain technology to promote circular fashion—A case study of leather handbags". *Journal of Cleaner Production*, 373, 133557.
- Siderius, T., and Poldner, K. (2021). "Reconsidering the circular economy rebound effect: Propositions from a case study of the Dutch Circular Textile Valley". *Journal of Cleaner Production*, 293, 125996.
- Singh, J., Sung, K., Cooper, T., West, K., and Mont, O. (2019). "Challenges and opportunities for scaling up upcycling businesses—The case of textile and wood upcycling businesses in the UK". *Resources, Conservation and Recycling*, 150, 104439.
- Stone, C., Windsor, F. M., Munday, M., and Durance, I. (2020). "Natural or synthetic—how global trends in textile usage threaten freshwater environments". *Science of the Total Environment*, 718, 134689.
- Tan, T. M., Makkonen, H., Kaur, P., and Salo, J. (2022). "How do ethical consumers utilize sharing economy platforms as part of their sustainable resale behavior? The role of consumers' green consumption values". *Technological Forecasting and Social Change*, 176, 121432.
- Turunen, L. L. M., and Halme, M. (2021). "Communicating actionable sustainability information to consumers: The Shades of Green instrument for fashion". *Journal of Cleaner Production*, 297, 126605.
- Valor, C., Ronda, L., and Abril, C. (2022). "Understanding the expansion of circular markets: Building relational legitimacy to overcome the stigma of second-hand clothing". *Sustainable Production and Consumption*, 30, 77-88.
- Wesley, C., Pahlevani, F., Nur-A-Tomal, S., Biswal, S., and Sahajwalla, V. (2023). "An investigation into the minimum energy requirements for transforming end-of-life cotton textiles into carbon fibre in an Australian context". *Resources, Conservation & Recycling Advances*, 17, 200123.
- Williams, C. (2007). "Research methods". *Journal of Business & Economics Research (JBER)*, 5(3).
- Xue, X., Caiguo, X., Yi, L., and Chenxia, M. (2022). "Consumption of traditional handicraft fashion: motivations, intentions and behaviours of Chinese consumers". *Cleaner and Responsible Consumption*, 4, 100046. <https://doi.org/10.1016/j.clrc.2021.100046>
- Young, M., and Muller, J. (2015). *Curriculum and the specialization of knowledge: Studies in the sociology of education*. Routledge.

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