Cultivating Circular Design in Fashion Education: Navigating Challenges and Fostering Sustainable Practices

Prakash Dutt and Archana Gandhi

Abstract

The fashion industry's growing pursuit of sustainability has spurred interest in circular design, a paradigm aimed at replacing linear consumption patterns with regenerative models. Embracing circularity, the fashion industry could mitigate its environmental and social footprint by extending product lifecycles, minimizing waste, and emphasizing recycling and reuse. This research explores perceptions, attitudes, and challenges faced by fashion designers and design students in the context of sustainable fashion and circular design principles. A mixed methods approach was employed to analyze the data including in-depth interviews and structured survey as well as qualitative thematic analysis and quantitative analysis. The study indicated ranging familiarity with terms related to sustainable fashion among designers and students. Though the participants were aware of the value of sustainable principles in design, they struggled with integrating sustainability into their practices. The internal challenges encompassed a lack of clarity surrounding sustainable design, trade-offs with aesthetic concerns, and the absence of design-led approaches. The external challenges included navigating the sustainability landscape complexities, closing consumer demand gaps, and addressing underdeveloped business incentives.

This research underscores the importance of collaborative approaches, innovative design strategies, and industry-specific tools in fostering sustainable fashion practices within the fast-paced fashion industry. It also emphasizes the crucial role of designers in advancing circular design and driving sustainable fashion solutions, highlighting their responsibility in shaping a more environmentally conscious and circular fashion landscape. The study indicates that fashion professionals lack expertise in ethical material sourcing, traceability, waste audits, sustainable regulations, certifications, and life cycle assessments, especially compared to other sectors focused on social responsibility. Design education plays a critical role in integrating sustainable practices into the fashion system. Circular design is essential for curricula aimed at developing

innovative and adaptable professionals who can meet the evolving sustainability demands of the industry. Social, ethical, and environmental considerations are central to this approach, equipping future designers to navigate the complexities of sustainable fashion.

Keywords: Sustainable fashion, circular design, designers' perceptions, challenges, sustainable design education, social and ethical parameters

Introduction

The fashion industry, renowned for its intricate global supply chains and rapid production-consumption cycles, stands as a significant contributor to resource depletion and environmental degradation (Supriyanto et al., 2022; Johnson and Plepys, 2021). This industry's inherent complexities, driven by evolving trends and consumer demands, present a formidable challenge to achieving sustainability (Mezgebe et al., 2023). The primary objective of this study is to examine the various challenges associated with the integration of circular design and sustainable practices within the fashion industry.

The foundations of the fashion industry's current predicament can be traced back to the advent of the linear economy—the "take-make-use-dispose" paradigm that emerged during the Industrial Revolution (Thinakaran et al., 2023a). Throughout history, this model has driven global economic development, shaping patterns of production and consumption that have profound ecological and societal implications (Zeltina, 2021). In parallel, the role of designers has been instrumental in shaping this trajectory, unwittingly perpetuating a linear approach (Dam et al., 2020; Hugo, Nadae and Lima, 2021). However, this article asserts that designers, who were key facilitators of the linear economy's ascendancy, possess the latent potential to usher in a paradigm shift towards a circular economy. While the linear model once reigned supreme, the unsustainability of its practices is increasingly evident. Scarce natural resources, hazardous chemicals, social exploitation, and mounting clothing waste underscore the fashion industry's multifaceted challenges.

The linear production and consumption patterns, particularly prevalent in developed countries, have rendered the fashion sector one of the most resource-intensive and ecologically damaging (Thinakaran et al., 2023a). The study focuses on how the shift from a linear economy to a circular one can address these issues through innovative design and sustainable approaches. The emergence of a circular economy that mimics regenerative processes presents a hopeful solution. However, navigating this shift comes with hurdles and limitations that require maneuvering. Overcoming obstacles

like resistance to change and challenging consumption patterns, and reimagining design thinking are crucial steps to foster circular design.

The article highlights the importance of education, in developing curricula for sustainable development. Encouraging a transition to the circular economy requires more than just technical expertise. The shift to a circular economy demands not only technical skills but also a change in mindset and ethical obligations on the part of designers. Although there are challenges ahead education can serve as a foundation for empowering designers to lead sustainability initiatives in the fashion industry. Drawing upon insights from historical transitions, the complexities of contemporary fashion, and the transformative potential of design education, this study contributes to the ongoing discourse on circular design and its implementation within the fashion industry. Aligned with these objectives, the research investigates how professionals in the fashion design sector perceive, engage with, and navigate sustainable fashion practices. It delves into the barriers and drivers of circular and sustainable fashion design and evaluates the adoption of existing tools and resources.

Sustainability vs. circularity: distinctive approaches in fashion's eco-conscious evolution

In contemporary fashion, the terms 'sustainability'' and 'circularity' have emerged as pivotal discourses, often used interchangeably yet encapsulating distinct paradigms. Both concepts advocate for a more responsible and eco-conscious approach to fashion, but they originate from divergent principles and methodologies (Gil-Lamata and Latorre-Martinez, 2022; Ozdamar-Ertekin, 2019; Wegener et al., 2023).

Sustainability in fashion primarily emphasizes the production and consumption processes that minimally impact the environment and society (Patwary, 2020). Sustainable fashion seeks to ensure that every stage of a product's lifecycle—from raw material extraction to garment disposal—adheres to ethical and environmentally benign practices (Dominish et al., 2018). This perspective encapsulates a broad spectrum, including organic raw materials, fair labor practices, reduced carbon footprints, and minimized waste (Rani, 2019). The goal is to strike a balance, ensuring that the needs of the present do not compromise the well-being of future generations.

On the other hand, circularity, or circular fashion, draws inspiration from the cyclic nature of the ecosystem (Gomes et al., 2022; Lucchetti et al., 2019). It challenges the traditional linear model of 'take, make, dispose' that has been prevalent in the fashion

industry (Thinakaran et al., 2023b). Instead, circular fashion emphasizes a closed-loop system (Knošková, 2020) where products are designed for longevity, can be easily recycled, and ideally regenerate new products at the end of their life (Chen et al., 2019). This approach inherently reduces waste by reintroducing post-consumer items back into the production cycle, either through recycling, upcycling, or repurposing (Sung, Cooper and Kettley, 2019). The essence of circularity is not just to reduce the negative impacts but to create a regenerative system that positively benefits both the environment and society (Ghaithan et al., 2023).

While both sustainability and circularity aim for reduced environmental footprints and ethical consumerism (D'Adamo et al., 2022), their core differences lie in their approach to achieving these goals (Koszewska, Rahman and Dyczewski, 2020). Sustainability in fashion is a holistic approach, integrating ethical considerations at every step of the product lifecycle (McNeill and Moore, 2015). Circularity, meanwhile, challenges and reimagines the very lifecycle of a product, ensuring that fashion items never truly reach an 'end', but instead contribute to a continuous cycle of utility (Pal, Shen and Sandberg, 2019).

In conclusion, while sustainability and circularity in fashion share overlapping objectives and often inform one another, they are distinct in their foundational principles and strategies. Recognizing the nuances between these two is crucial for academics, industry practitioners, and consumers alike, ensuring that the fashion industry evolves in a manner that is both responsible and regenerative.

Fostering sustainability through design thinking, circular economy principles, and educational strategies

In the realm of sustainable development and the mitigation of environmental challenges, there exists a noteworthy interconnection among the concepts of design thinking, the circular economy, and education for sustainability. Design thinking as a methodology places particular emphasis on fostering empathy, encouraging collaborative efforts, and advocating for iterative problem-solving as essential components for the development of innovative solutions (Sumter, Bakker and Balkenende, 2018). Transitioning to the circular economy, this framework aims to reduce waste generation and optimize resource utilization through practices such as product and material reutilization, repair, and recycling (Mendoza, Gallego-Schmid and Azapagic, 2019). Integrating these principles into educational curricula and institutions forms the basis of education for sustainability (Tilbury et al. 2003).

Design thinking is a collaborative problem-solving and human-centric approach that fosters innovation by elevating participants' creative thinking abilities (Aflatoony, Wakkary and Neustaedter, 2017). It has drawn interest in several domains, including design, education, and business (Liedtka, 2014). To meet the demand for new skills in the twenty-first century, design thinking has been included in different secondary and post-secondary education curricula (Aflatoony, Wakkary, and Neustaedter, 2017). This helps resolve complicated issues in a wide range of non-design domains, such as business, healthcare, social science, and library services (ibid.). A thorough framework for tackling sustainability issues can be obtained by combining design thinking, circular economy, and instructional techniques. Design thinking is a useful technique in sustainability education because it helps students develop their critical and creative thinking abilities, which empowers them to address complex sustainability issues from a human-centered perspective (Clark, Stabryla, and Gilbertson, 2020). Students and professionals can create creative solutions that take into consideration the social, economic, and environmental facets of sustainability by utilizing design thinking principles (Clark, Stabryla, and Gilbertson, 2020). It is critical to build the requisite knowledge, techniques, and resources to successfully integrate design thinking and the concepts of the circular economy into educational models that support sustainability.

Furthermore, the circular economy provides a framework for incorporating sustainable practices into educational institutions. Universities have the chance to improve waste reduction, resource efficiency, and sustainable campus management (Mendoza, Gallego-Schmid, and Azapagic, 2019). Universities can create plans to reduce their environmental impact and provide a more sustainable learning environment by adopting the concepts of the circular economy (ibid.).

In conclusion, "design thinking," the "circular economy," and "education for sustainability" are interconnected concepts that can contribute to addressing environmental challenges and promoting sustainable development (Wiek, Withycombe and Redman, 2011). By integrating design thinking principles and circular economy strategies into educational curricula and institutions, we can foster creative problem-solving skills and promote sustainable practices (Wiek, Withycombe and Redman, 2011). Overall, design thinking offers a practical and effective approach for addressing sustainability challenges in education. It empowers students to think critically, consider multiple dimensions of sustainability, and develop innovative solutions. By incorporating design thinking into curricula, educators can enhance students' creative thinking abilities and prepare them for the complex challenges of the twenty-first century (Clark, Stabryla and Gilbertson, 2020). However, further research and empirical evidence are needed to fully understand

the role of design and the implementation of circular economy thinking in educational contexts (Sumter et al., 2020).

Background of Research

The essence of the fashion industry is grounded in its perpetual state of evolution and the demand for constant innovation, whereas sustainability is closely linked to durability and preservation (Hailemariam and Nuramo, 2023). The definition of sustainable fashion remains multifaceted, and there exists a notable disparity between consumers' intentions and actions in terms of environmentally conscious behaviors (Wang et al., 2022). The difficulties encountered in adopting sustainable consumption practices can be categorized into three primary domains: individual, social, and cultural experiences (Li et al., 2020; Niedek and Krajewski, 2021; Raippalinna, 2022).

The fashion industry's fast-paced consumer demand often clashes with sustainability principles aimed at long-term balance (Hur and Cassidy 2019a; Dobos 2022; Thinakaran et al. 2023c). This inherent tension highlights the disconnect between the industry's constant change and sustainability's enduring nature, which aims to balance environmental, social, and economic issues (Azam et al., 2022; Groschopf, Dobrovnik and Herneth, 2021). Previous studies show a significant gap between consumers expressed environmental concerns and their purchasing behaviors, further complicated by skepticism towards green products (Moorthy et al., 2023; Caldas et al., 2021; Mavlutova et al., 2021). Addressing these challenges requires a comprehensive approach that integrates design thinking, circular economy principles, and targeted educational strategies (Tilbury et al., 2003; Sumter, Bakker and Balkenende, 2018).

By understanding these tensions and gaps, we can better address the challenges within the fashion industry's sustainability efforts and develop strategies to bridge the disconnect between consumer intentions and actions. Addressing these challenges requires a comprehensive approach that integrates design thinking, circular economy principles, and targeted educational strategies (ibid.).

Fashion designers and design professionals now stand at the forefront of a pivotal moment, where they possess the potential to spearhead a transformative shift (Kam and Yoo, 2022). Beyond their traditional role in crafting for a "closed loop," they wield the capacity to shape both business practices and consumer behavior, ultimately extending the lifespan of products and enhancing their perceived value (Lee and Weder, 2021; Ta, Aarikka-Stenroos and Litovuo, 2022). For this vision to materialize, though, a dual transformation is imperative. Some designers must reorient their practices,

while others need to undergo a fundamental shift in both their methods and mindset (Tladi, Mokgohloa and Bignotti, 2021). Currently, sustainable design, encompassing the principles of the circular economy, remains conspicuously absent as a mandatory facet of the design profession (Ceylan, 2021; Chien, Yao and Chao, 2020). Additionally, this paradigm shift is often perceived by many established fashion designers as an unwelcome addendum to an already extensive list of design considerations (Heim, 2022). As a result, some are hesitant to embrace sustainability as an integral aspect of their work (Kam and Yoo, 2022; Nistor and Bálint, 2022). One viable approach is to encourage established designers to actively seek knowledge and expertise in circular and sustainable design through continuous professional development.

This study takes a mixed-methods exploratory approach to unpack these complexities (Jalil and Shaharuddin, 2020; Kam and Yoo, 2022). It aims to understand the views and challenges of fashion design practitioners regarding sustainable fashion, as well as their awareness of current sustainability tools and methods valuable for design. The overarching purpose is to shed light on sustainable design perceptions and strategies within fashion. Specifically, this study aims to:

- Identify key barriers to the adoption of circular design principles.
- Analyze the levels of understanding and engagement with sustainability among different stakeholder groups, including designers, students, and educators.
- Investigate the impact of these challenges on the implementation of sustainable practices.
- Propose educational strategies to address identified gaps in knowledge and facilitate the adoption of sustainable practices.

Research Methods

The current study employed a mixed-method approach, integrating qualitative and quantitative methodologies (Hesse-Biber, 2010; Youngs and Piggot-Irvine, 2011), to get a thorough examination. This investigation employed a research methodology that blended open-ended and closed-ended inquiries to comprehensively investigate the significant obstacles associated with sustainable fashion. Moreover, the study sought to explore the intricate beliefs and attitudes that are prevalent among the fashion design community. This study sought to achieve two main aims by carefully combining qualitative and quantitative approaches (Caldas, 2003; Lewis, 2015). Firstly, it wanted

to demonstrate clear relationships between variables through systematic designs. Secondly, it aimed to create an opportunity for the development of explanatory insights.

To examine sustainability issues relevant to the fashion industry, a comprehensive inventory was carefully developed, incorporating insights derived from prior academic literature. The inventory was specifically designed to encompass several aspects of sustainable fashion. Subsequently, an assessment was conducted on each category within this framework using a Likert scale (Stratton, 2018), which provided a measurable gauge of the respondents' viewpoints. Likewise, a comprehensive examination of previous studies revealed a range of obstacles that impede the smooth incorporation of sustainable practices in the fashion business (Choi and Li, 2015; Lee, Kim and Yang, 2015). The aforementioned impediments, which are indicative of a wide range of issues, were subsequently recognized and documented.

Data collection and analysis

This study conducted comprehensive face-to-face interviews (Hilgert, Kroh and Richter, 2016) with 13 professionals working in the fashion business, primarily focusing on individuals employed as fashion designers and technical designers. The purpose of conducting these interviews was to gain a thorough and genuine comprehension of the subject matter. To enhance the reliability of the research outcomes, the data underwent a process called triangulation, wherein cross-verification and corroboration were conducted (Youngs and Piggot-Irvine, 2011).

The participants were purposefully selected, with a specific focus on individuals who were actively involved in the field of fashion design. A hybrid approach involving both online surveys and semi-structured interviews was utilized, with the surveys being self-administered to cohorts of individuals affiliated with fashion design. To broaden the pool of respondents, the researchers employed the snowball sampling method, in which participants referred to or invited additional individuals.

The research sample was drawn from diverse geographical places, encompassing China, Bangladesh, India, Vietnam, Turkey, Germany, and the United Kingdom. A diverse group of people, including designers, educators, professionals employed in the fashion sector, and fashion design students, actively participated in the questionnaire. The voluntary nature of participation resulted in a sample that had a greater inclination towards environmental consciousness in comparison to the wider population within the fashion and textile design industry. The research had a sample size of 88 participants (Table 1).

Table 1: Participants' description

Fashion Designers	26
Technical Designers	12
Product Development Professionals	22
Design Students	18
Educators	10
Total	88

The data analysis process employed in this study was comprehensive, incorporating both quantitative and qualitative methodologies (Caldas, 2003; Lewis, 2015). A thematic examination of the content was performed to determine the significant themes and determinants present in the qualitative data that was supplied in textual format (Caldas, 2003; Lewis, 2015). This process entailed a thorough analysis of transcripts, systematically dissecting them on a line-by-line basis. The process of open coding was employed to categorize topics, facilitating the establishment of linkages and enabling comparisons across many thematic groups (Lewis, 2015). The utilization of a multidimensional analytical technique enabled a comprehensive and in-depth examination of the gathered data (Edwards, 2001).

Metrics explanation

To categorize the participants' levels of knowledge and engagement, specific metrics were used:

- **No Knowledge:** Participants have no prior knowledge or experience with the concepts.
- **Limited Knowledge:** Participants have some basic understanding but lack comprehensive knowledge or experience.
- **Good Knowledge:** Participants have a sound understanding of the concepts and can apply them in practical scenarios.
- **Proficient and Actively Engaged:** Participants thoroughly understand the concepts and are actively involved in applying them in their professional practices.

This categorization provided a clear framework for assessing the varying levels of sustainability knowledge and engagement among different participant groups.

Results

Circular and sustainable fashion refers to the implementation of clothing production and consumption strategies that strive to minimize waste and mitigate environmental impact. Additionally, it emphasizes the importance of durability and ethical manufacturing procedures. The participants were provided with instructions to express their current understanding of circularity and sustainability in the context of apparel and textile design.

In the pursuit of understanding sustainability and circularity within the realm of fashion design, the present research delineated 11 principal categories (Table 2). These categories were meticulously curated, drawing inspiration from distinct sustainability and circularity challenges previously identified in the literature review. These categories not only encapsulated the multifaceted nature of sustainability in fashion but also resonated with findings from prior studies, thereby reinforcing their pertinence in the ongoing discourse.

Table 2: Principal categories

Category	Relevance to Circularity	References
Materials	Pertains to the selection of sustainable raw materials and recycled materials, essential for creating products within a circular model.	(Nayak et al., 2019; Yadav, Kar and Raj, 2022)
Design for Longevity	Designing for longevity reduces the need for frequent replacements, promoting reuse and minimizing waste.	(Öndoğan et al., 2016; Stenton et al., 2021; Zakrzewska-Bielawska and Lewicka, 2021)
Waste Reduction	Central to circularity, it emphasizes minimizing waste at every product lifecycle stage.	(Chernysh and Roubík, 2020; Enes and Kipöz, 2019; Wang, Zhang and Ullah, 2022)
Circular Business Models	Business models like product-as-a-service or sharing platforms that are designed to support circular economy principles.	(Cao et al., 2022; Khajavi, 2021; Peters and Simaens, 2020)
Upcycling and Recycling	Upcycling adds value to waste materials, while recycling ensures materials are reused—both are essential in a circular economy.	(Charnley et al., 2022; Kim, 2015; Sung,Cooper and Kettley, 2019)

Category	Relevance to Circularity	References
Social Responsibility	While broader than just circularity, responsible social practices often align with sustainable and circular business practices.	(Hoejmose and Adrien-Kirby, 2012; Park-Poaps and Rees, 2009; Zorzini Linda; Huq FahianAnisul; Stevenson Mark, 2015)
Consumer Engagement	Engages consumers in sustainable practices, like returning products for recycling or buying refurbished items, supporting the circular model.	(Austgulen, 2015; Balan, 2020; Koszewska, Rahman and Dyczewski, 2020; Moorthy et al., 2023)
Lifecycle Assessment	Evaluating a product's environmental impact throughout its lifecycle identifies areas to reduce waste and increase efficiency.	(Maaß, Spruit and Waal, 2014; Moreno et al., 2016)
Regulations and Certifications	Guide or mandate circular practices, ensuring businesses adhere to sustainable and circular principles.	(Baumgartner, 2019; Hasbullah et al., 2023; Oelze, Gruchmann and Brandenburg, 2020; Sartor et al., 2016)
Innovation and Technology	Drives more efficient recycling processes, the development of new materials, or the creation of platforms for sharing and reusing products.	(Spychalska-Wojtkiewicz, 2020; Suwartha et al., 2018; Vegera et al., 2018)
Collaboration and Industry Trends	Collaborative efforts, like industry partnerships, accelerate the shift towards a circular economy by sharing resources, knowledge, and best practices.	(Arias et al., 2022; Balan, 2020; Delbufalo and Bastl, 2018; Elkington, 1998; Gonçalves and Silva, 2021; Vachon and Klassen, 2008)

Upon meticulous examination of the dataset, distinct patterns of knowledge distribution among participants across various sustainability-related domains were observed. Within the realm of sustainable material selection (Figure 1), 75 percent of the cohort demonstrated adequate knowledge or proficiency about 'natural and organic fibers'. Similarly, 62.5 percent of participants displayed strong proficiency in the 'recycled materials (fabric & trims)' domain. Conversely, certain areas exhibited a notable deficit in participant proficiency. For instance, in 'ethical material sourcing' and 'material traceability', only 36.4 percent and 35.2 percent of participants, respectively, were categorized as knowledgeable or proficient. These gaps highlight the areas in which participants lacked awareness or practical experience, pointing towards a need for stronger emphasis on ethical sourcing and traceability within fashion education programs.

In the case of waste management strategies (Figure 2), participants displayed good understanding in 'material waste reduction techniques' and 'efficient pattern making'. However, only a mere 13.7 percent exhibited good knowledge or proficiency in 'waste auditing and analysis'.

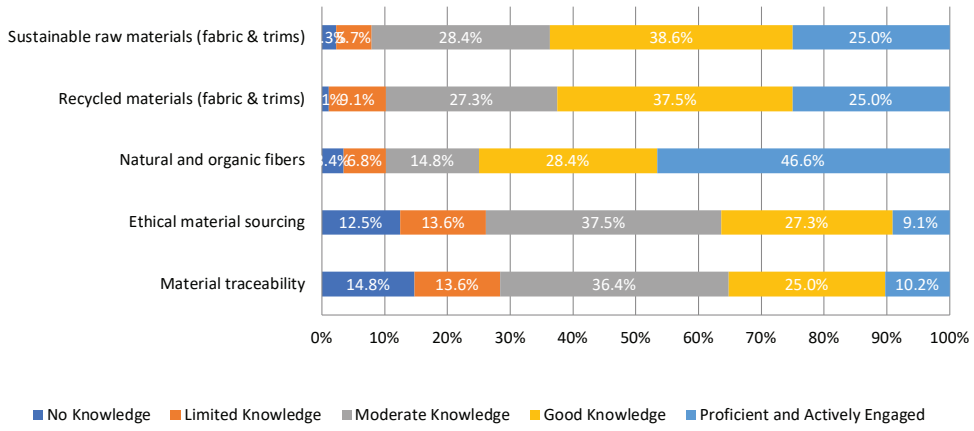

Figure 1: Proficiency levels in sustainable material selection

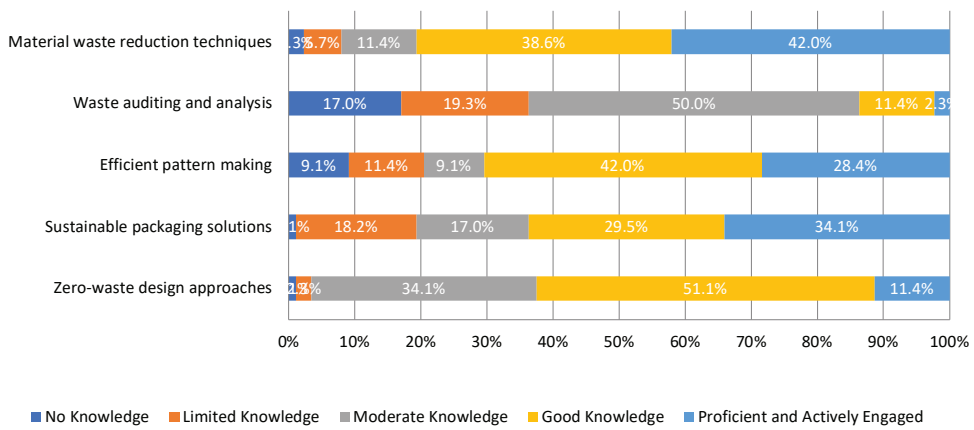

Figure 2: Proficiency levels in waste reduction strategies

In the realm of designing for longevity, while many participants showcased moderate to high competence (Figure 3), there was a sharp decline in familiarity with material reuse, where participants expressed limited knowledge or engagement in circular design principles and collaborations with recycling facilities (Figure 4). Though some participants demonstrated high proficiency in 'circular business models' (Figure 5), others displayed only basic understanding, indicating inconsistent familiarity with sustainable business practices, such as product-as-a-service or sharing platforms. This lack of understanding suggests that areas tied to circular economy concepts are not being effectively covered in existing fashion curricula.

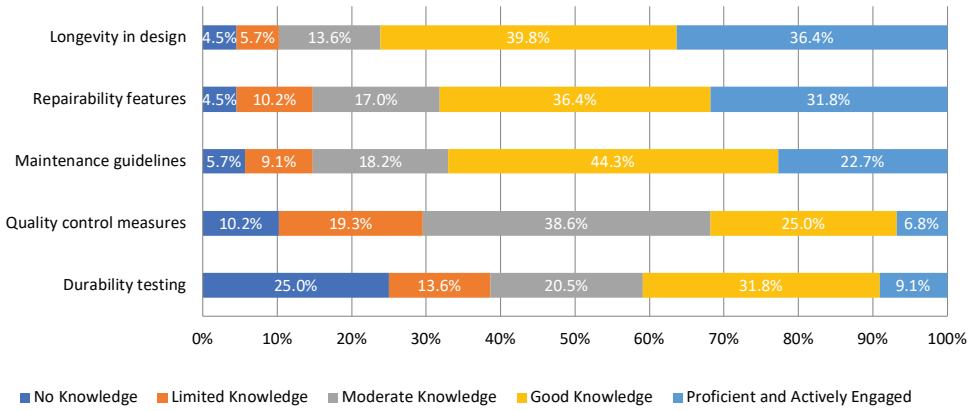

Figure 3: Proficiency levels in design for longevity

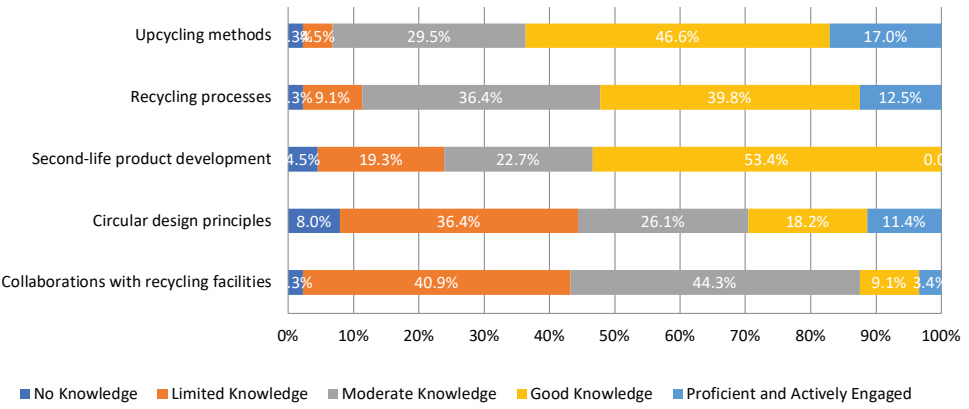

Figure 4: Proficiency levels in upcycling and recycling

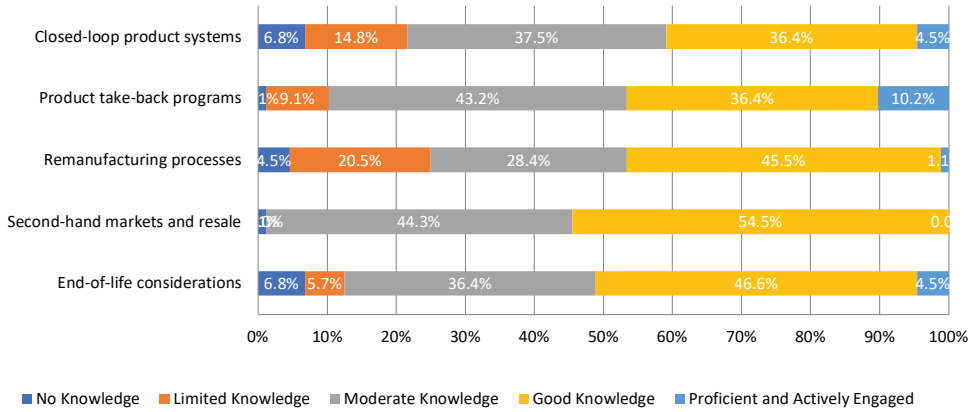

Figure 5: Proficiency levels in circular business models

The results highlighted knowledge gaps in the areas of 'industry trends and collaborative efforts' (Figure 6) and 'technological innovations in sustainability' (Figure 7). While a subset of participants demonstrated a good grasp of these domains, a significant portion reported limited awareness, reflecting a broader gap in educational focus on industry collaboration and innovation.

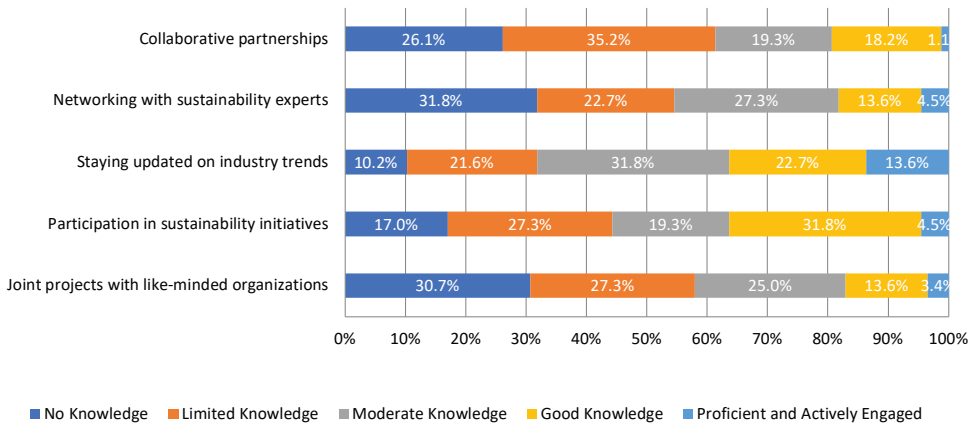

Figure 6: Proficiency levels in industry trends and collaborative efforts in sustainability

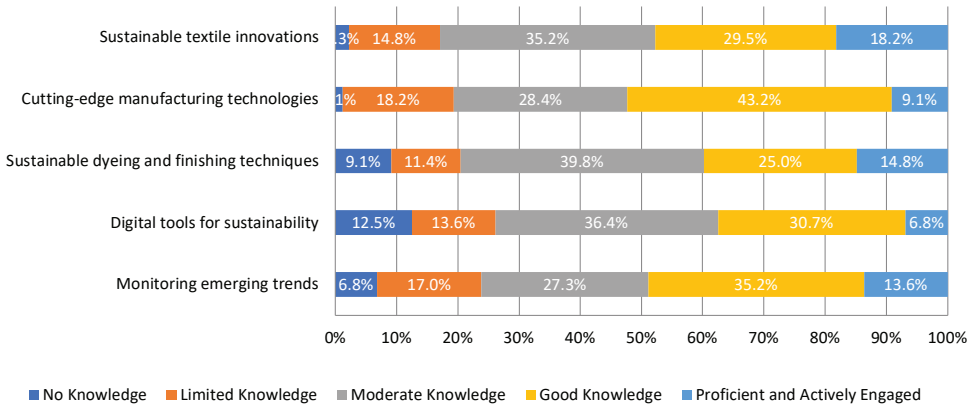

Figure 7: Proficiency levels in technological innovations in sustainability

Regarding regulatory understanding of 'sustainable fashion regulations and certifications' (Figure 8), only 14.8 percent and 15.9 percent of the participants demonstrated a thorough understanding of 'certification in audit process' and 'compliance with ethical standards', respectively. This was corroborated by Figure 9, revealing a limited proficiency in conducting Environmental Impact Assessment (EIA), especially carbon footprint analysis. These results directly relate to concerns in fashion education, where there may be a lack of regulatory knowledge and practical application of sustainability standards.

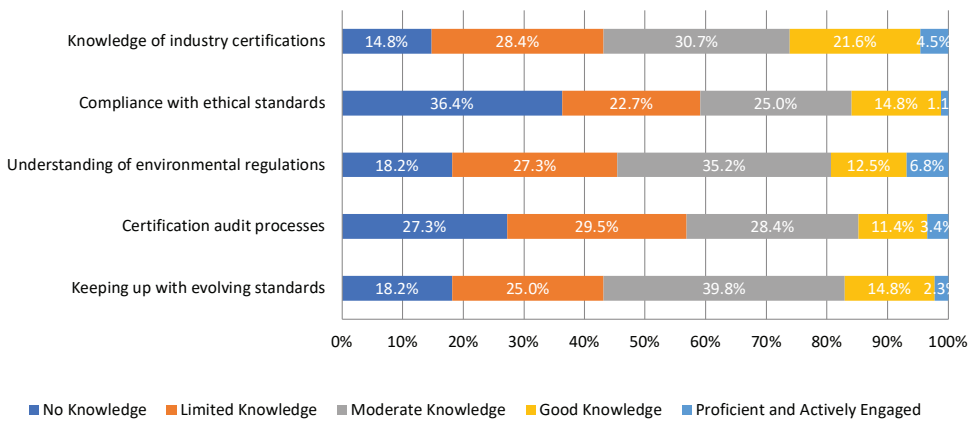

Figure 8: Proficiency levels in sustainable fashion regulations and certifications

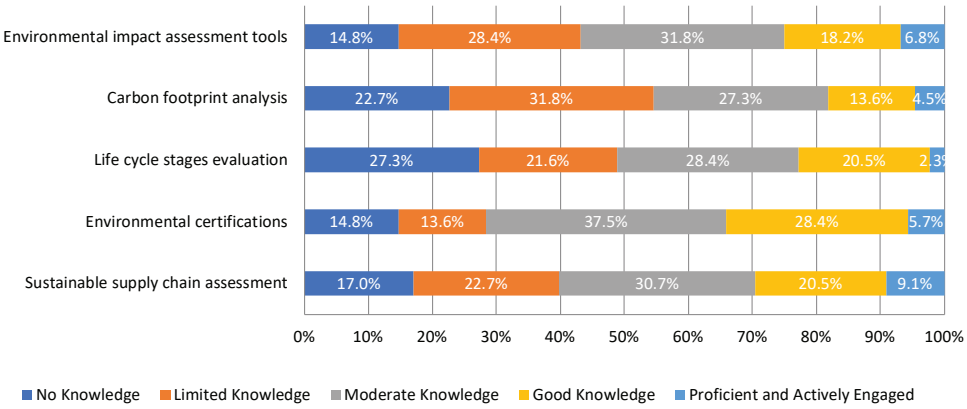

Figure 9: Proficiency levels in environmental impact assessment

Finally, the results from 'engaging consumers in sustainable fashion' (Figure 10) and 'ethical and socially responsible practices' (Figure 11) showed moderate levels of engagement. Although some participants actively applied these concepts, a significant number only had a surface-level understanding, which again points to an educational gap in engaging consumers and applying ethical practices.

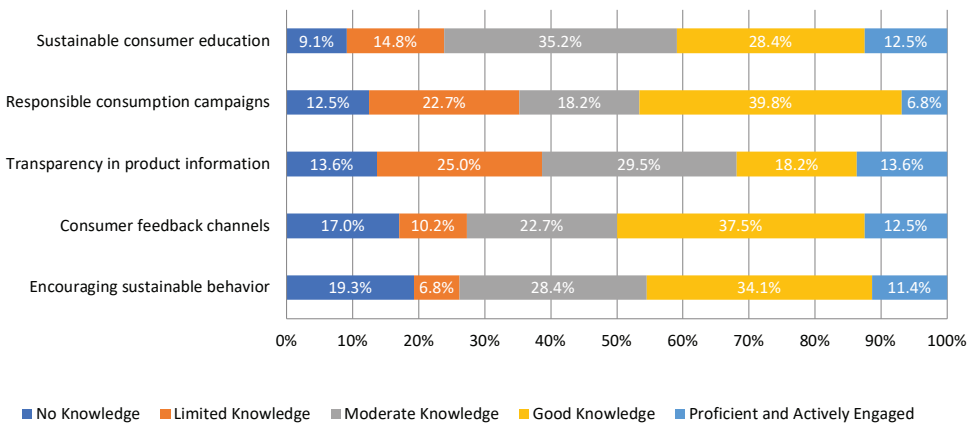

Figure 10: Proficiency levels in engaging consumers in sustainable fashion

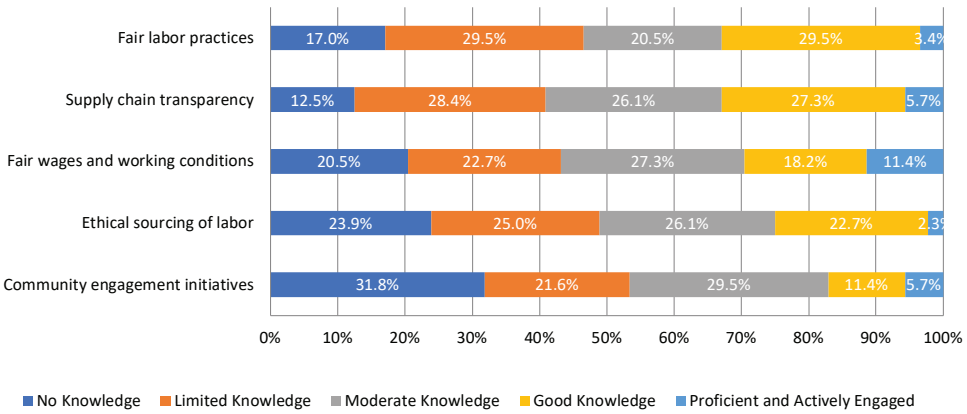

Figure 11: Proficiency levels in ethical and socially responsible practices

In conclusion, these findings indicate that while participants demonstrated a thorough understanding of sustainable material selection and waste reduction techniques, there were pronounced knowledge gaps in some of the key domains. These included ethical sourcing, material traceability, circular business models, and regulatory compliance. Fashion education programs can bridge these gaps by prioritizing a comprehensive approach to sustainability and circularity, equipping future designers with the necessary skills to tackle these crucial areas.

Recognizing the awareness levels and application domains in sustainable and circular fashion design

The purpose of this research was to evaluate the participants' professional involvement and awareness of circularity and sustainability in fashion design. The research encapsulated a thorough taxonomy with 13 different categories and 65 sub-categories within the broader framework of sustainable and circular fashion design. These categories are intricately linked with previous research in the realms of sustainability, circularity, and sustainable design.

'Sustainable materials', 'design for lifespan', and 'waste reduction approaches' were the three most conscious categories among the many evaluated. These groups displayed negligible standard deviations, suggesting a higher level of competence and mastery in these areas. In contrast, 'social responsibility' and 'regulations and certifications' were the least understood topics, suggesting a significant lack of familiarity among the

respondents. Additionally, the ranking of 'lifecycle assessment' showed a significantly higher degree of variance when taking the standard deviation into account. Several participants acknowledged that they had not previously thought about or were unfamiliar with these specific categories, highlighting a notable practical awareness gap.

In the survey, a majority of the respondents, precisely 60%, identified themselves as sustainable designers actively involved in practicing sustainable fashion. Nevertheless, the actual implementation and current performance of these sustainable systems appeared to be relatively suboptimal.

Discussion

The initial phases of design within the fashion business have been recognized as crucial, exerting a significant influence on approximately 80 percent of the environmental consequences throughout the complete lifespan of a product (Hur and Cassidy, 2019b; Kozlowski, Bardecki and Searcy, 2019; Teowarang, Kurniawan and Lunn, 2022; Todeschini et al., 2017). Despite the acknowledged significance of this issue, there is a lack of comprehensive academic research that specifically explores the views and attitudes of fashion professionals toward sustainable fashion. Moreover, there is a lack of research regarding the difficulties encountered in incorporating sustainability ideas into design techniques.

This study was undertaken to address the existing research gap by centering on the multifaceted challenges that are intrinsic to the implementation of circularity and sustainability within the domain of fashion design. The investigation yielded a comprehensive list of key challenges, including the following:

Ambiguity in defining circularity and sustainability: The main obstacle was the lack of agreement on how to interpret sustainability and circularity in the context of fashion aesthetics. The interpretation mostly hinged on eco-friendly design and sustainable material selections, yet a unanimous understanding remained elusive due to the complex nature of circular and sustainable concepts.

Reconciliation of circularity and sustainability with design criteria: Secondly, designers had the difficult task of balancing competing design criteria, including cost, trends, style, and aesthetics, with circularity and sustainability. Environmentally friendly practices and the use of circular and sustainable materials were seen as onerous, mostly because of the time-consuming and costly nature of these endeavors.

Comprehensive circular and sustainable strategies: Participants discussed the potential for expanding circular and sustainable processes to incorporate eco-friendly dyes, printing, and surface treatments, notwithstanding the rise of recycling to prominence as a sustainable design practice. It was underlined that comprehensive approaches, such as upcycling design and sustainable packaging, are required to handle the full product lifecycle.

Knowledge deficit: Interestingly, the poll revealed a lack of knowledge about social responsibility, ethical sourcing, and the laws and certifications about sustainable and circular fashion design. In this context, these components are seen to be crucial for achieving a thorough understanding of circularity and sustainability, underscoring the pressing need for extensive education and awareness initiatives in these fields.

Underutilization of circular and sustainable design tools and resources: Lastly, the research highlighted the underutilization of existing circular and sustainable design tools and resources among both professional designers and fashion design students. It pointed to the necessity for bespoke tools tailored specifically to the intricacies of the fashion and textile design sectors. These tools should emphasize visual and interactive components, facilitating seamless integration into the day-to-day practices of designers.

The noteworthy discovery of this study is the lack of knowledge in areas like social responsibility, compliance, waste auditing and analysis, material traceability, and ethical material procurement. The complexity of these ideas, inadequate exposure during professional training, and a scarcity of thorough instructional resources are probably the causes of these gaps. The implications of these gaps are substantial, as they hinder the ability of designers and industry professionals to implement effective sustainable practices. Addressing these gaps through targeted educational initiatives is critical for advancing sustainability in the fashion industry. The study advocates for an increased emphasis on education and awareness about various facets of ethical sourcing, regulatory compliance, certifications, and the rigorous application of scientific life cycle assessment methodologies. These efforts work together to achieve comprehensive sustainability in the area of fashion design.

Conclusion

This study explored the attitudes, engagement, and perspectives of fashion designers regarding the challenges of integrating sustainability and circularity into fashion design. Designers play a vital role in promoting sustainable design practices, as they significantly influence consumer behavior and production methods, ultimately supporting sustainable development.

The research pointed to various challenges faced by the industry professionals while incorporating circularity into the fashion design process. These challenges included human, organizational, societal, and cultural factors. Internally, there was a lack of consensus among stakeholders about the specific interpretation of sustainability in fashion design. Additionally, designers perceived a conflict between sustainability and other design objectives, such as aesthetics, cost, and current fashion trends. There was also limited awareness of the available sustainable design tools and how to apply them. The fashion industry lacked comprehensive circular design concepts and technologies necessary to promote and advance sustainability. Furthermore, external challenges included the complexity of sustainability issues, perceived lack of consumer interest in sustainable fashion, discrepancies in consumer attitudes and behaviors affecting purchasing decisions, and perceived deficiencies in business incentives to adopt sustainable design strategies.

Addressing the gaps in awareness and knowledge identified in this study is essential. Significant deficiencies were found in areas such as ethical material sourcing, material traceability, waste auditing, and analysis, as well as regulations and certifications. These gaps highlight the need for comprehensive educational programs that offer in-depth training on these topics. Educational institutions must innovate and adapt curricula to include thorough training on sustainable practices. By doing so, they can prepare future designers to tackle the complex challenges of sustainability in the fashion industry. This emphasis on fashion education underscores the vital role academic institutions play in shaping a sustainable future for fashion.

Future research can significantly advance the field by focusing on cross-comparative case studies that explore the effective challenges and solutions related to integrating sustainability into the business models of manufacturing companies, design houses, and retail brands. Additionally, investigating cross-cultural differences in the challenges fashion designers face when adopting circular design practices can provide valuable insights and foster collaboration. Moreover, comparative studies examining the varying expectations, motivations, and challenges encountered by designers and consumers in their pro-environmental actions and sustainable consumption will deepen our understanding of these vital areas and guide us toward more impactful solutions.

In conclusion, addressing the gaps identified in this study through improved educational practices can foster the development of comprehensive sustainable fashion methods. By embracing circular design and incorporating strong educational frameworks, designers can play a significant role in transforming the industry toward sustainability.

This will also encourage the evolution of fashion education to become more innovative and adaptable.

References

Aflatoony, L., Wakkary, R.andNeustaedter, C., 2017. Becoming a Design Thinker: Assessing the Learning Process of Students in a Secondary Level Design Thinking Course. *International Journal of Art & Design Education.* [e-journal] 37(3), pp. 438-453. https://doi.org/10.1111/jade.12139.

Arias, C., Beltrán, J.M.Q., Ariza, J.M.M, Lozano, J.B.C. and Bernal, M.A.B., 2022. Pro-Circular Consumer Profile: An Approach to Their Identification and Characterization Based on the Components of the Value-Belief-Norm Theory. *Sustainability*.

Austgulen, M.H., 2015. Environmentally Sustainable Textile Consumption—What Characterizes the Political Textile Consumers? *Journal of Consumer Policy,* 39, pp.441–466.

Azam, T., Malik, S., Ren, D., Yuan, W., Mughal, Y.H., Ullah, I., Fiaz, M. and Riaz, S., 2022. The Moderating Role of Organizational Citizenship Behavior Toward Environment on Relationship Between Green Supply Chain Management Practices and Sustainable Performance. Front Psychol.

Balan, C., 2020. How Does Retail Engage Consumers in Sustainable Consumption? A Systematic Literature Review. *Sustainability*, [e-journal] 13(1). https://doi.org/10.3390/su13010096.

Baumgartner, R.J., 2019. Sustainable Development Goals and the Forest Sector - A Complex Relationship. *Forests*. [e-jouranl] 10(2), 152. https://doi.org/10.3390/f10020152.

Caldas, M., 2003. Research design: qualitative, quantitative, and mixed methods approaches. Revista De AdministraçãoContemporânea, 7(1), 223-223. https://doi.org/10.1590/s1415-65552003000100015

Caldas, M.V.D. A., Veiga-Neto, A.R., Guimarães, L.G.D.A., Castro, A.B.C.D and Pereira, G.R.B., 2021. Greenwashing in Environmental Marketing Strategy in the Brazilian Furniture Market. *Revista De Economia eSociologia Rural*, [e-journal] 59(3). https://doi.org/10.1590/1806-9479.2021.225336.

Cao, H., Cobb, K., Yatvitskiy, M., Wolfe, M. and Shen, H., 2022. Textile and Product Development From End-of-Use Cotton Apparel: A Study to Reclaim Value From Waste. *Sustainability,* [e-journal] 14(14). https://doi.org/10.3390/su14148553.

Ceylan, S., 2021. Adapting Sustainability and Energy Efficiency Principles to Architectural Education: A Conceptual Model Proposal for the Design Studio Sequence. *4th International Conference on Green Energy and Sustainable Development (GESD)*. Shenyang City, China, 13-14 November 2021.

Charnley, F., Knecht, F., Muenkel, H., Pletosu, D., Rickard, V., Sambonet, C., Schneider, M. and Zhang, C., 2022. Can Digital Technologies Increase Consumer Acceptance of Circular Business Models? The Case of Second Hand Fashion. *Sustainability*, [e-journal] 14(8), https://doi.org/10.3390/su14084589.

Chen, X., An, J., Cai, G., Zhang, J., Chen, W., Dong, X., Zhu, L., Tang, B., Wang, J. and Wang, X., 2019. Environmentally Friendly Flexible Strain Sensor From Waste Cotton Fabrics and Natural Rubber Latex. *Polymers (Basel),* [e-journal] 11(3). https://doi.org/10.3390/polym11030404.

Chernysh, Y. and Roubík, H., 2020. International Collaboration in the Field of Environmental Protection: Trend Analysis and COVID-19 Implications. *Sustainability,*[e-journal] 12(24). https://doi.org/10.3390/su122410384.

Chien, Y-H., Yao, C-K. and Chao, Y-H., 2020. Effects of Multidisciplinary Participatory Design Method on Students' Engineering Design Process. *Eng—advances in Engineering*, [e-journal] 1(2), pp.112-121. https://doi.org/10.3390/eng1020007.

Choi, T-M. and Li, Y., 2015. Sustainability in Fashion Business Operations. *Sustainability,*[e-journal] 7(11), pp.15400-15406. https://doi.org/10.3390/su71115400.

Clark, R.M., Stabryla, L.M. and Gilbertson, L.M., 2020. Sustainability Coursework: Student Perspectives and Reflections on Design Thinking. *International Journal of Sustainability in Higher Education,* 21(3).

D'Adamo, I., Lupi, G., Morone, P. and Settembre-Blundo, D., 2022. Towards the circular economy in the fashion industry: the second-hand market as a best practice of sustainable responsibility for businesses and consumers. *Environmental Science and Pollution Research*, [e-journal] 29(31), pp. 46620-46633. https://doi.org/10.1007/s11356-022-19255-2.

Dam, K.V., Simeone, L., Keskin, D., Baldassarre, B., Niero, M. and Morelli, N., 2020. Circular Economy in Industrial Design Research: A Review. *Sustainability,* [e-journal] 12(24). https://doi.org/10.3390/su122410279.

Delbufalo, E. and Bastl, M., 2018. Multi-principal collaboration and supplier's compliance with codes-of-conduct. *The International Journal of Logistics Management,* 29(4), pp.1237–1254.

Dobos, E., 2022. Changing Landscapes but Ingrained Power Relations? The Green Promise of the COVID-19 Pandemic, the (Un)sustainability of the Fashion Industry, and the Central-Eastern European Production Background. *Acta Universitatis Sapientiae Social Analysis*. [e-journal] 12(1). pp.1-27. https://doi.org/10.2478/aussoc-2022-0001.

Dominish, E., Retamal, M., Sharpe, S., Lane, R., Rhamdhani, M.A., Corder, G., Giurco, D. and Florin, N., 2018. "Slowing" and "Narrowing" the Flow of Metals for Consumer Goods: Evaluating Opportunities and Barriers. *Sustainability,* [e-journal] 10(4). https://doi.org/10.3390/su10041096.

Edwards, J.R., 2001. Multidimensional Constructs in Organizational Behavior Research: An Integrative Analytical Framework. *Organizational Research Methods,* [e-journal] 4(2), 144–192. https://doi.org/10.1177/109442810142004.

Elkington, J., 1998. Partnerships from cannibals with forks: The triple bottom line of 21st-century business. *Environmental Quality Management*, 6, pp.37–51.

Enes, E. and Kipöz, Ş., 2019. Türkiye Moda Endüstrisinin Kesim Atık Problemi Ve Atık Yönetim Stratejileri. *Journal of Textiles and Engineer*, [e-journal] 26(113), pp.97-103. https://doi.org/10.7216/1300759920192611311.

Ghaithan, A.M., Alshammakhi, Y., Mohammed, A. and Mazher, K.M., 2023. Integrated Impact of Circular Economy, Industry 4.0, and Lean Manufacturing on Sustainability Performance of Manufacturing Firms. *International Journal of Environmental Research and Public Health,* [e-journal] 20(6), 5119. https://doi.org/10.3390/ijerph20065119.

Gil-Lamata, M. and Latorre-Martinez, P., 2022. The Circular Economy and Sustainability: A Systematic Literature Review. *Cuadernos De Gestión,* 22(1), pp.129-142.

Gomes, G.M., Moreira, N.,Bouman, T., Ometto, A.R. and Werff, E.V.D., 2022. Towards Circular Economy for More Sustainable Apparel Consumption: Testing the Value-Belief-Norm Theory in Brazil and in the Netherlands. *Sustainability,* [e-journal] 14(2). https://doi.org/10.3390/su14020618.

Gonçalves, A. and Silva, C., 2021. Looking for Sustainability Scoring in Apparel: A Review on Environmental Footprint, Social Impacts and Transparency. *Energies (Basel),* [e-journal] 14(11). https://doi.org/10.3390/en14113032.

Groschopf, W., Dobrovnik, M. and Herneth, C., 2021. Smart Contracts for Sustainable Supply Chain Management: Conceptual Frameworks for Supply Chain Maturity Evaluation and Smart Contract Sustainability Assessment. [online] Available at: <https://www.frontiersin.org/journals/blockchain/articles/10.3389/fbloc.2021.506436/full> [Accessed 12August 2023].

Hailemariam, L.M. and Nuramo, D.A., 2023. Exploring the Design Practice, Trends, and Gaps of Urban Bridges in Ethiopia towards Sustainability. *Advances in Civil Engineering*, [e-journal] 2023(1), pp.1-14. https://doi.org/10.1155/2023/1211492.

Hasbullah, N.N., Kiflee, A.K.R., Sulaiman, Z., Mas'od, A. and Rahim, H., 2023. Communicating Sustainability Fashion in Marketing Advertisements on the Context of Malaysia: Stimuli Development and Pre-Testing Results. *Asian Social Science,* [e-journal] 19(1). 10.5539/ass.v19n1p36.

Heim, H., 2022. Change of Mind: Marketing Social Justice to the Fashion Consumer. *International Journal for Crime Justice and Social Democracy,*[e-journal] 11(2), pp.02-15. https://doi.org/10.5204/ijcjsd.2405.

Hesse-Biber, S., 2010. Qualitative Approaches to Mixed Methods Practice. *Qualitative Inquiry,*[e-journal] 16(6), pp.455-468. https://doi.org/10.1177/1077800410364611.

Hilgert, L., Kroh, M. and Richter, D., 2016. The Effect of Face-to-Face Interviewing on Personality Measurement. *Journal of Research in Personality,* [e-journal] 63, pp.133-136. https://doi.org/10.1016/j.jrp.2016.05.006.

Hoejmose, S.U. andAdrien-Kirby, A.J., 2012. Socially and environmentally responsible procurement: A literature review and future research agenda of a managerial issue in the 21st century. *Journal of Purchasing and Supply Management,*[e-journal] 18(4), pp.232–242. https://doi.org/10.1016/j.pursup.2012.06.002.

Hugo, A.D.A., Nadae, J.D. and Lima, R.D.S., 2021. Can Fashion Be Circular? A Literature Review on Circular Economy Barriers, Drivers, and Practices in the Fashion Industry's Productive Chain. *Sustainability,* [e-journal] 13(21). https://doi.org/10.3390/su132112246.

Hur, E. and Cassidy, T., 2019. Perceptions and Attitudes towards Sustainable Fashion Design: Challenges and Opportunities for Implementing Sustainability in Fashion. *International Journal of Fashion Design Technology and Education,* [e-journal] 12(2), pp.208-217. https://doi.org/10.1080/17543266.2019.1572789.

Jalil, M.H. andShaharuddin, S.S., 2020. Fashion Designer Behavior Toward Eco-Fashion Design. *Journal of Visual Art and Design,* [e-journal] 12(1). https://doi.org/10.5614/j.vad.2020.12.1.1.

Johnson, E. and Plepys, A., 2021. Product-Service Systems and Sustainability: Analysing the Environmental Impacts of Rental Clothing. *Sustainability,* [e-journal] 13(4). https://doi.org/10.3390/su13042118.

Kam, S. and Yoo, Y., 2022. Practice of Sustainable Fashion Design Considering Customer Emotions and Personal Tastes. *Frontiers in psychology,* [e-journal] 13, https://doi.org/10.3389/fpsyg.2022.976471.

Khajavi, S.H., 2021. Additive Manufacturing in the Clothing Industry: Towards Sustainable New Business Models. *Applied Sciences*, [e-journal] 11(19). https://doi.org/10.3390/app11198994.

Kim, H.E., 2015. A Study on the Characteristics and Trends of Sustainable Fashion through Esthetica at London Fashion Week. *Fashion & Textile Research Journal*, 17(2), pp.168-177.

Knošková, L., 2020. Circular Design and Consumer Involvement in Circular Economy. *Studia CommercialiaBratislavensia*, [e-journal] 13(43), pp.25-34. https://doi.org/10.2478/stcb-2020-0001.

Koszewska, M., Rahman, O. andDyczewski, B., 2020. Circular Fashion – Consumers' Attitudes in Cross-National Study: Poland and Canada. *Autex Research Journal,* [e-journal] 20(3), pp.327-337. https://doi.org/10.2478/aut-2020-0029.

Kozlowski, A., Bardecki, M. and Searcy, C., 2019. Tools for Sustainable Fashion Design: An Analysis of Their Fitness for Purpose. *Sustainability,* [e-journal] 11(13). https://doi.org/10.3390/su11133581.

Lee, E.E. and Weder, F., 2021. Framing Sustainable Fashion Concepts on Social Media. An Analysis of #Slowfashionaustralia Instagram Posts and Post-Covid Visions of the Future. *Sustainability,* [e-journal] 13(17), pp.1-17. https://doi.org/10.3390/su13179976.

Lee, S.H-N., Kim, H.J. and Yang, K., 2015. Impacts of Sustainable Value and Business Stewardship on Lifestyle Practices in Clothing Consumption. *Fashion and Textiles,* [e-journal] 2(17).https://doi.org/10.1186/s40691-015-0043-8.

Lewis, S., 2015. Qualitative Inquiry and Research Design: Choosing Among Five Approaches. *Health Promotion Practice.*[e-journal] 16(4), pp.473-475. https://doi.org/10.1177/1524839915580941.

Li, Z., Yuan, J., Du, B., Hu, J., Yuan, W., Palladini, L., Yu, B. and Zhou, Y., 2020. Customer Behavior on Purchasing Channels of Sustainable Customized Garment with Perceived Value and Product Involvement. *Frontiers in psychology,*[e-journal] 11. https://doi.org/10.3389/fpsyg.2020.588512.

Liedtka, J., 2014. Perspective: Linking Design Thinking With Innovation Outcomes through Cognitive Bias Reduction. *Journal of Product Innovation Management,* [e-journal] 32(6), pp.925-938. https://doi.org/10.1111/jpim.12163.

Lucchetti, M.G., Paolotti, L., Rocchi, L. and Boggia, A., 2019. The Role of Environmental Evaluation within Circular Economy: An Application of Life Cycle Assessment (LCA) Method in the Detergents Sector. *Environmental and Climate Technologies,* 23(2).

Maaß, D., Spruit, M. and Waal, P.D., 2014. Improving short-term demand forecasting for short-lifecycle consumer products with data mining techniques. *Decision Analytics,* [e-journal] 1(4). https://doi.org/10.1186/2193-8636-1-4.

Mavlutova, I., Kuzmina, J., Uvarova, I., Atstaja, D., Lesinskis, K., Mikelsone, E. andBrizga, J., 2021. Does Car Sharing Contribute to Urban Sustainability From User-Motivation Perspectives? *Sustainability,* [e-journal] 13(19). https://doi.org/10.3390/su131910588.

McNeill, L. and Moore, R., 2015. Sustainable Fashion Consumption and the Fast Fashion Conundrum: Fashionable Consumers and Attitudes to Sustainability in Clothing Choice. *International Journal of Consumer Studies,* [e-journal] 39(3), pp.212-222. https://doi.org/10.1111/ijcs.12169.

Mendoza, J.M.F., Gallego-Schmid, A. and Azapagic, A., 2019. A Methodological Framework for the Implementation of Circular Economy Thinking in Higher Education Institutions: Towards Sustainable Campus *ManagementJournal of Cleaner Production,* [e-journal] 226, pp.831-844. https://doi.org/10.1016/j.jclepro.2019.04.060.

Mezgebe, T.T., Gebreslassie, M.G., Sibhato, H. and Bahta, S.T., 2023. Intelligent Manufacturing Eco-System: A Post COVID-19 Recovery and Growth Opportunity for Manufacturing Industry in Sub-Saharan Countries. *Scientific African,* [e-journal] 19. https://doi.org/10.1016/j.sciaf.2023.e01547.

Moorthy, V.G., Moorthy, A.G., Rashid, U.N.A.H.B.U.H.A., Heang, T.P. and Kanapathipillai, K., 2023. A Study on the Influence of Eco-Friendly Factors That Inspire Consumers' Purchasing Intention in Klang Valley, Malaysia. *European Journal of Social Sciences Studies,* [online] Available at: <https://oapub.org/soc/index.php/EJSSS/article/view/1443/2022> [Accessed 29 September 2023]

Moreno, M., Rios, C.D.L.R., Rowe, Z. and Charnley, F., 2016. A Conceptual Framework for Circular Design. *Sustainability,* [e-journal] 8(9). https://doi.org/10.3390/su8090937

Nayak, R., Singh, A., Panwar, T. and Padhye, R., 2019. A Review of Recent Trends in Sustainable Fashion and Textile Production. *Current Trends in Fashion Technology & Textile Engineering*, [e-journal] 4(5), pp.101-118. 10.19080/CTFTTE.2019.04.555648.

Niedek, M. and Krajewski, K., 2021. Ethical Consumption as the Basis for Counteracting Food Waste. *Environmental Protection and Natural Resources,* [e-journal] 32(3). https://doi.org/10.2478/oszn-2021-0009.

Nistor, L. and Bálint, G., 2022. Attitudes towards Sustainable Fashion in Romania. *Acta Universitatis Sapientiae Social Analysis,* [e-journal] 12(1), pp.28-52. 10.2478/aussoc-2022-0002.

Oelze, N., Gruchmann, T., and Brandenburg M., 2020. Motivating Factors for Implementing Apparel Certification Schemes—A Sustainable Supply Chain Management Perspective. *Sustainability,* [e-journal]12(12). https://doi.org/10.3390/su12124823.

Öndoğan, Z., Kiliç, A.Ş., Boz, S., Tama, D., Encan, B.C. and Necef, Ö.K., 2016. Research on Sportswear Buying Behavior of University Students. *SHS Web of Conferences*, [e-journal] 26. https://doi.org/10.1051/shsconf/20162601113.

Ozdamar-Ertekin, Z., 2019. Can Luxury Fashion Provide a Roadmap for Sustainability? *Markets Globalization & Development Review,* [online] Available at: <https://digitalcommons.uri.edu/cgi/viewcontent.cgi?article=1102&context=mgdr> [Accessed 02 November 2023].

Pal, R., Shen, B. and Sandberg, E., 2019. Circular Fashion Supply Chain Management: Exploring Impediments and Prescribing Future Research Agenda. *Journal of Fashion Marketing and Management*, [e-journal] 23(3), pp.298-307. https://doi.org/10.1108/JFMM-07-2019-166.

Park-Poaps, H. andRees, K., 2009. Stakeholder Forces of Socially Responsible Supply Chain Management Orientation. *Journal of Business Ethics,* [e-journal] 92, pp.305–322. https://doi.org/10.1007/s10551-009-0156-3.

Patwary, S., 2020. Clothing and Textile Sustainability: Current State of Environmental Challenges and the Ways Forward.*Textile& Leather Review,* [online] Available at: <https://www.researchgate.net/publication/344834216_Clothing_and_Textile_Sustainability_Current_State_of_Environmental_Challenges_and_the_Ways_Forward> [Accessed 07 November 2023].

Peters, J. and Simaens, A., 2020. Integrating Sustainability Into Corporate Strategy: A Case Study of the Textile and Clothing Industry. *Sustainability,* [e-journal] 12(15), https://doi.org/10.3390/su12156125.

Raippalinna, L-M., 2022. Banal Sustainability: Renewing the Cultural Norm of Not Wasting Food. *Ethnologia Europaea,* [e-journal] 52(1), pp.1-23. https://doi.org/10.16995/ee.4804.

Rani, S., 2019. Impact of Sustainable Manufacturing Practices on Financial Performance of MSME in Coimbatore District. *International Journal of Engineering and Advanced Technology,* [e-journal] 9(1S4). 10.35940/ijeat.A1222.1291S419.

Sartor, M., Orzes, G., Mauro, C.D., Ebrahimpour, M. and Nassimbeni, G., 2016. The SA8000 social certification standard: Literature review and theory-based research agenda. *International Journal of ProductionEconomics,*[e-journal] 175, pp.164–181.https://doi.org/10.1016/j.ijpe.2016.02.018.

Spychalska-Wojtkiewicz, M., 2020. The Relation between Sustainable Development Trends and Customer Value Management. *Sustainability,* [e-journal] 12(14). https://doi.org/10.3390/su12145496.

Stenton, M., Kapsali, V., Blackburn, R.S. and Houghton, J.A., 2021. From Clothing Rations to Fast Fashion: Utilising Regenerated Protein Fibres to Alleviate Pressures on Mass Production. *Energies (Basel),* [e-journal] 14(18), 5654; https://doi.org/10.3390/en14185654.

Stratton, S.J., 2018. Likert Data. *Prehospital and Disaster Medicine,* [e-journal] 33(2), pp.117-118. https://doi.org/10.1017/S1049023X18000237.

Sumter, D., Bakker, C. and Balkenende, R., 2018. The Role of Product Design in Creating Circular Business Models: A Case Study on the Lease and Refurbishment of Baby Strollers. *Sustainability,* [e-journal] 10(7). https://doi.org/10.3390/su10072415.

Sumter, D., Koning, J.D., Bakker, C. and Balkenende, R., 2020. Circular Economy Competencies for Design. *Sustainability,* [e-journal] 12(4). https://doi.org/10.3390/su12041561

Sung, K., Cooper, T. and Kettley, S., 2019. Developing Interventions for Scaling Up UK Upcycling. *Energies (Basel),* [e-journal] 12(14). https://doi.org/10.3390/en12142778.

Supriyanto, Adawiyah, W.R., Arintoko, Rahajuni, D. and Kadarwati, N., 2022. Economic Growth and Environmental Degradation Paradox in ASEAN: A Simultaneous Equation Model with Dynamic Panel Data Approach. *Environmental Economics,* [e-journal] 13(1), pp.171-184. http://dx.doi.org/10.21511/ee.13(1).2022.14.

Suwartha, N., Berawi, M.A., Surjandari, I., Zagloel, T.Y.M., Setiawan, E.A., Atmodiwiryo, P. and Yatmo, Y.A., 2018. Creating Sustainable Future through Integration of Management, Design, and Technologies. *International Journal of Technology,* [e-journal] 9(9), p. 1518-1522. https://doi.org/10.14716/ijtech.v9i8.2770.

Ta, A.H., Aarikka-Stenroos, L. and Litovuo, L., 2022. Customer Experience in Circular Economy: Experiential Dimensions among Consumers of Reused and Recycled Clothes. *Sustainability,* [e-journal] 14(1). https://doi.org/10.3390/su14010509.

Teowarang, J.R., Kurniawan, M.N. and Lunn, C.V., 2022. Creating Sustainable Fashion Collection Made of Handloom Textile for Australian Market. *Corak,* [e-journal] 11(1). https://doi.org/10.24821/corak.v11i1.6842.

Thinakaran, S., Chandravelu, P., Ponnambalam, S.G., Sankaranarayanan, B. and Karuppiah, K., 2023. Analyzing the Challenges to Circular Economy in Indian Fashion Industry. *IEEE Access*, [e-journal] 11, pp.711-727. 10.1109/ACCESS.2022.3233197.

Tilbury, D., Stevenson, R.B., Fien, J. and Schreuder, D., 2003. Education and Sustainability: Responding to the Global Challenge. *International Journal of Sustainability in Higher Education*, [e-journal] 4(2), https://doi.org/10.1108/ijshe.2003.24904bae.007.

Tladi, B., Mokgohloa, K. and Bignotti, A., 2021. Towards a Relational Framework of Design. *The South African Journal of Industrial Engineering,* [e-journal] 32(3), pp.75-85. http://dx.doi.org/10.7166/32-3-2622.

Todeschini, B.V., Cortimiglia, M.N., Callegaro-de-Menezes, D. and Ghezzi, A., 2017. Innovative and Sustainable Business Models in the Fashion Industry: Entrepreneurial Drivers, Opportunities, and Challenges. *Business Horizons,* [e-journal] 60(6), pp.759-770. https://doi.org/10.1016/j.bushor.2017.07.003.

Vachon, S. and Klassen, R.D., 2008. Environmental management and manufacturing performance: The role of collaboration in the supply chain. *InternationalJournal of ProductionEconomics,*[e-journal] 111(2), pp.299–315.https://doi.org/10.1016/j.ijpe.2006.11.030.

Vegera, S., Malei, A., Sapeha, I. and Sushko, V., 2018. Information Support of the Circular Economy: The Objects of Accounting at Recycling Technological Cycle Stages of Industrial Waste. *Journal of Entrepreneurship and Sustainability Issues,* [e-journal] 6(1), pp.190-210. .http://doi.org/10.9770/jesi.2018.6.1(13).

Wang, H., Zhang, F. and Ullah, K., 2022. Waste Clothing Recycling Channel Selection Using a CoCoSo-D Method Based on Sine Trigonometric Interaction Operational Laws With Pythagorean Fuzzy Information. *Energies (Basel),* [e-journal] 15(6). https://doi.org/10.3390/en15062010.

Wang, X., Waris, I., Bhutto, M.Y., Sun, H. and Hameed, I., 2022. Green Initiatives and Environmental Concern Foster Environmental Sustainability: A Study Based on the Use of Reusable Drink Cups. *International Journal of Environmental Research and Public Health,* [e-journal] 19(15). https://doi.org/10.3390/ijerph19159259.

Wegener, K., Damm, O., Harst, S., Ihlenfeldt, S., Monostori, L., Teti, R., Wertheim, R. and Byrne, G., 2023. Biologicalisation in manufacturing – Current state and future trends. *CIRP Annals*, [e-journal] 72(2), pp.781–807.https://doi.org/10.1016/j.cirp.2023.05.005.

Wiek, A., Withycombe, L. and Redman, C.L., 2011. Key Competencies in Sustainability: A Reference Framework for Academic Program Development. *Sustainability Science,* 6, pp.203-218. https://doi.org/10.1007/s11625-011-0132-6.

Yadav, S.S., Kar, S.K. and Rai, P.K., 2022. Why Do Consumers Buy Recycled Shoes? An Amalgamation of the Theory of Reasoned Action and the Theory of Planned Behaviour.*Frontiers in Environmental Science,* [e-journal] 10. https://doi.org/10.3389/fenvs.2022.1007959.

Youngs, H. and Piggot-Irvine, E., 2011. The Application of a Multiphase Triangulation Approach to Mixed Methods. *Journal of Mixed Methods Research*, [e-journal] 6(3), https://doi.org/10.1177/155868981142069.

Zakrzewska-Bielawska, A. and Lewicka, D., 2021. A Company's Relational Strategy: Linkage between Strategic Choices, Attributes, and Outcomes. *PLoSOne,*[online] Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8297868/#:~:text=These%20strategic%20choices%20are%20not,main%20attributes%20of%20interfirm%20collaboration.> [Accessed 08 November 2023].

Zeltina, M., 2021. Design Thinking for Sustainable Development. *Turkish Journal of Computer and Mathematics Education (Turcomat),* [online] Available at: <https://turcomat.org/index.php/turkbilmat/article/view/2477> [Accessed 08 November 2023].

Zorzini, M.,Hendry, L.C., Huq, F.A., and Mark, S., 2015. Socially Responsible Sourcing: Reviewing the Literature and its use of theory. *International Journal of Operations & Production Management,* [e-journal] 35, pp.60–109. https://doi.org/10.1108/IJOPM-07-2013-0355.

About the authors

Prakash Dutt is a seasoned professional with an extensive track record of over 20 years in the global apparel industry. Currently serving as the head of the quality assurance and corporate social responsibility departments at Asmara Group, Prakash has honed his expertise in product quality management, global sourcing, apparel manufacturing, sustainability, and corporate social responsibility. In addition to his corporate role, he is a dedicated research scholar at the National Institute of Fashion Technology in New Delhi. His research focuses on advancing social and environmental sustainability initiatives within the Bangladesh apparel sector. Prakash holds an MBA in Fashion Management from Subharti University and a Post Graduate Diploma in Environmental Law and Practices from National Law University, New Delhi. His multifaceted career reflects his unwavering commitment to fostering positive change in the fashion industry.

prakash.dutt@nift.ac.in

Archana Gandhi is Professor at NIFT and has a PhD from the Faculty of Management Studies at Delhi University. She has been with NIFT, Department of Fashion Technology, Delhi, since 1999, after working with Triburg for six years. Her areas of teaching, research, training, and consulting have been apparel merchandising, quality management, product development, and sustainability. She has been involved in mapping key performance indicators for merchandisers and also training merchandisers for various apparel organizations. She was a guest faculty member at Colorado State University, USA, in 2009. Apart from publishing numerous research papers in international journals, she has authored a book on apparel merchandising and contributed to chapters in the books, 'Dimensional Corporate Governance—An Inclusive Approach,' published by Springer Publication, and 'Fashion Interfaces: Proposals for Sustainability,' by Universidade de São Paulo. Archana has also been regularly reviewing research articles and papers for leading international journals.

archana.gandhi@nift.ac.in