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Research on Multi-Functional Fashion Contributes to Sustainable Development

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Abstract

The study addresses the environmental impact of fast fashion and garment waste by exploring the development of sustainable, multifunctional fashion. The research aims to reduce excessive consumption while maintaining both aesthetic and functional appeal. It focuses on transformation techniques, such as adjustable cuts, detachable elements, and convertible features, to enhance garment versatility and extend product lifecycles. By analyzing fashion trends among youth, a group with significant influence over fashion markets, the study identifies key stylistic preferences and integrates them into the design process. Additionally, the research investigates using recycled materials and refined tailoring methods to promote eco-friendly production practices. The results reveal that these designs offer unique, adaptable fashion items that align with sustainable trends, combining diverse styles and high functionality. The study demonstrates that flexible, reusable designs can encourage consumers to make more sustainable fashion choices, reducing textile waste while still allowing for creativity and self-expression in clothing. By promoting multifunctional garments, the research highlights the potential for fashion to contribute to a circular economy, where longevity, adaptability, and eco-consciousness are prioritized in consumer habits. This approach not only offers practical solutions to environmental concerns but also supports the broader shift towards sustainable fashion.

Keywords: Recycled materials, sustainable fashion, transformable clothing.

1. Introduction

In the context of ever-evolving fashion, the choice of clothes not only stops at daily use but also becomes a means to express personality and personal style. However, the explosion of fast fashion has led to many consequences, such as clothing waste and negative environmental impacts. The United Nations calls the fashion industry the second most polluting of all industries, generating 8% of total carbon emissions and 20% of total global wastewater [1]. This requires the fashion industry to find creative solutions to balance aesthetics, versatility, and sustainability. Transformative fashion allows users to use products in various ways, providing more diverse experiences.

Transformative fashion has become an inspiration for many designers around the world, especially in the context of the fashion industry's increasing emphasis on sustainability and creativity. One of the most iconic designers is Iris Van Herpen, who combines technology and fashion and has created shape-changing designs, using special materials such as 3D printing. The Shift Soul collection (Fig. 1) [2] was launched at Paris Haute Couture Spring/Summer 2019 and is an iconic collection by Iris Van Herpen, a unique combination of fashion, science, technology, and art. Earlier in 2007 at Paris Fashion Week Spring/Summer, designer Hussein Chalayan presented the One Hundred and Eleven collection (Fig. 2) [3], which showcased the idea of time transformation through fashion by using cutting-edge technology to create transformative dresses right on the runway, inspired by how dress styles have evolved over the decades.

Fig. 1. Shift soul couture collection 2019

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Fig. 2. Hussein Chalayan 2007 S/S

Anna and Iwona (2024), in their study "Transformable Clothing in Children's Fashion," examine how adaptable clothing supports a child's psychophysical development while offering economic benefits for parents. These garments, designed to adjust as the child grows or to serve multiple functions, promote sustainability and cost-effectiveness [4].

Concurrently, Nemeša *et al.* (2024) explore how transformable clothing design methods can allow a single textile item to be worn in multiple styles in their paper, "Transformable clothing to reduce pre- and post-consumer textile waste." This approach helps extend the garment's lifecycle and reduces both pre- and post-consumer textile waste [5].

In a different application, Irovan *et al*. (2016) conduct experimental studies focused on creating women's clothing using morphological transformation techniques in their work, "Using the Principles of Transformation in the Development of New Design Clothes-Making for Women". Their research involves designing and producing transformable skirts, showcasing innovative garment adaptability [6].

Furthermore, Gong (2014) provides critical insight into designer and consumer interests and practices in fashion sustainability in the thesis "Sustainable fashion design: transformable garments for versatility and longevity." The designs presented in this project are noted for bringing sustainable fashion ideals closer to the mainstream [7].

Building upon existing research that affirms transformable fashion as a versatile and impactful field, this study aims to advance transformation methods while integrating aesthetic elements into wearable designs. Previous work has demonstrated its applicability across demographics and core benefits, including consumer savings, waste reduction via garment longevity, and technical innovation-positioning it as crucial for a sustainable fashion future. Our research seeks to build directly on this foundation.

2. Literature Review

2.1. Transformable Fashion: Creative Approach

Transformative clothing is an innovative concept that allows clothing to change shape or function, bringing multiple styles or uses from a single product, emphasizing versatility and sustainability. Transformative fashion has appeared since before the twentieth century through the reuse of fabrics and costumes during wars or periods of scarcity of resources, and in the early twentieth century, people began to use accessories to refresh and change old clothing designs. Multiway dresses change from long skirts to short skirts by removing part of the fabric. In 1985, Donna Karan made her mark with the "Seven Easy Pieces" (Fig. 3) collection, which consists of pieces made of jersey, which are highly practical, worn in layers but still feminine [8]. Experts assessed that at that time, her design revolutionized women's clothing in the United States, replacing rigid shoulder-padded suits.

Fig. 3. From the Archives: Donna Karan's Original 'Seven Easy Pieces'

Up to now, in the 21st century with many fluctuations and an increase in awareness of sustainability, many designers and brands have begun to focus on transformative fashion. Designs such as skirts that can be turned into tops, jackets that can be changed in length, or pants that can be turned into skirts are becoming more popular. In 2022, fashion house Dior launched the collection "The next era" under the leadership of creative director Maria Grazia Chiuri, as shown in Fig. 4. The designs in this collection combine fashion and technology. Bodysuits with arterial-like seams, glow in the dark when the spotlight is not on, creating the illusion of a suit moving on its own, with the "intervention" from D-Air Lab, this design will maintain a stable body temperature thanks to high-tech fibers [9].

Fig. 4. Bodysuit applies high-tech yarns in the collection "The next era"

2.2. Transformable Fashion: Sustainable Approach

According to the Fashion Research Journal: "Transformable fashion: The biggest sustainable clothing trend that never was" [10], transformable fashion represents a pinnacle of sustainable design, engineered to minimize waste and extend garment life through innovation [10]. Its core strengths are multifaceted: it reduces environmental impact by delaying obsolescence and diverting textiles from landfills; it meets modern consumer demand for versatile, multi-style clothing that merges aesthetics with sustainability; and it champions a "less is more" ethos, promoting longevity and countering overconsumption by encouraging mindful shopping habits. Replacing disposable fast fashion with high-quality, transformable garments is thus presented as an achievable objective [11]. This potential is further corroborated by previous studies, such as those "Exploring Sustainable Potential of Transformable Fashion" by Rosová (2024) [12] and "Sustainable Fashion Development: Applying Transformational Design" by Wei (2012) [13], which explore the sustainable applications of transformational design.

3. Research Methodology

3.1. Research Subject

This research, under the theme "Transformative Outfits," investigates the use of available recycled materials through sample analysis. It systematically synthesizes and evaluates the advantages and disadvantages of their functional features, aesthetic qualities, and practical suitability for application in fashion design. The study primarily utilizes recycled old products - particularly denim jeans - which are creatively transformed through strategic zipper integration. This approach is specifically tailored to fashion design targeting young adults aged 18–28, combining sustainable practices with innovative design techniques to meet the style preferences of this demographic.

In this study, the authors use available recycled jeans, including old denim garments sourced from surplus stock and second-hand jeans. These denim fabrics primarily consist of cotton blended with spandex, ensuring durability and flexibility in design. The use of recycled jeans not only minimizes environmental impact but also aligns with the creative concept of capturing small joyful moments, providing a sense of safety and happiness for generation Z through fashion.

3.2. Research Methods

In this study, the research team investigated transformable apparel through three main approaches: (1) Component analysis focusing on fundamental zipper types and their applications in design; (2) Comprehensive research evaluating the global and Vietnamese development of transformable fashion while analyzing trends and demands among young consumers; (3) Experimental synthesis and assessment of designs using diverse materials and colors to holistically analyze formal, functional, and user experience factors.

3.3. Design Research and Development

3.3.1. Trends 2025

The overview of fashion trends in 2025 mentioned in the STEPIC drivers, as shown in Fig. 5, includes: Society, Technology, Environment, Politics, Industry, and Creativity [14].

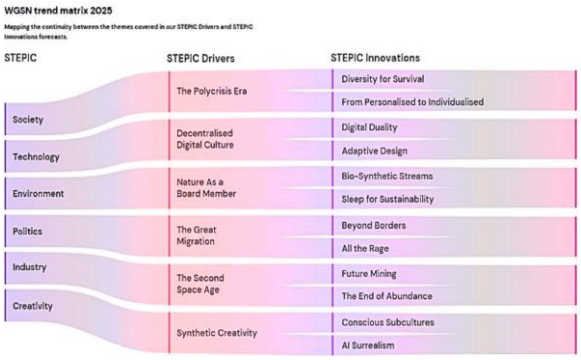

Fig. 5. 2025 STEPIC trends by WGSN

After the Covid-19 pandemic, people tend to focus more on quality instead of quantity, which strongly promotes interest in sustainable fashion. Environmental issues, especially waste from the fashion industry, are increasingly mentioned, posing an urgent need for eco-friendly solutions.

Therefore, when choosing materials to design, we prioritize the use of recycled clothing, combined with the methods mentioned above to create transformative, multifunctional products. This not only meets the creative goal but also clearly demonstrates the spirit of the research topic, aiming at sustainability and adaptability in fashion.

3.3.2. Research on young females from 18–28 years old

Women aged 18–28 are increasingly interested in sustainable fashion, prioritizing second-hand clothing, creative upcycling, and circular fashion to reduce environmental impact. They seek personalization, not just following trends but expressing their unique style through versatile, multifunctional designs. Social media plays a crucial role, enabling generation Z to quickly access trends and choose brands that align with their values. Additionally, they emphasize comfort and practicality, favoring fashion that is both stylish and sustainable, aligning with their modern lifestyle.

According to First Insight and the Wharton School (2022), 70% of generation Z consumers are willing to pay more for sustainable products [14]. A Thredup report (2023) revealed that 47% of generation Z had bought second-hand clothing in the past year [15].

Deloitte (2021) emphasized that over 57% of generation Z prefer customizable or limited-edition fashion [16]. WGSN's "Future Consumer 2025" suggests generation Z highly values multifunctionality in [17]. Furthermore, Vogue Business notes that 83% of generation Z discover fashion brands through social media platforms like TikTok and Instagram [18]. These trends highlight a clear shift toward ethical, customizable, and eco-conscious fashion consumption among younger generations.

3.3.3. Exploring the types of fasteners that can assist with fixation or adjustment in transformable clothing

Fasteners are a general term for components that help bind pieces of fabric, adjust shapes, or create the ability to transform a garment. In a transformative fashion, fasteners play an important role in helping clothes change shape, size, or function… There are many popular types of fasteners, including: zippers, buttons, snaps, hook-and-loop, magnets,...

Zippers are used to expand, collapse, or change the style of clothing. There are 3 common types of zippers, which are two-way zippers that help unlock in both directions, allowing the wearer to adjust the opening flexibly, hidden zippers that are hidden in the seams to create a sophisticated look, and Waterproof zippers that are often used in sportswear or tech fashion (Fig. 6).

a) b)

c)

Fig. 6. a) Two-way zipper, b) Hidden zipper, and c) Waterproof zipper

Building on the functional versatility of zippers demonstrated earlier, the Misconcept AW 2020 collection (Fig. 7 – Fig. 8) masterfully employs these fasteners to create garments that transform both their form and function.

a) b)

Fig. 7. Misconcept Autumn-Winter 2020 Lookbook a) T-shirt, b) Bag is transformed from T-shirt with zipper

a) b)

Fig. 8. Misconcept Autumn-Winter 2020 Lookbook a) jacket before zipping, b) jacket has a hood after zipping

Buttons (Fig. 9) help secure parts of fabric and can be removed to transform outfits.

Fig. 9. Buttons

Snaps provide an efficient solution for reversible garment restructuring, as exemplified by functional applications in denim products (Fig. 10) and commercial designs like the Fenty x Puma side-snap pants, which enable length transformation through strategically placed fasteners (Fig. 11).

Fig. 10. Snaps for denim products

Fig. 11. Side-snap pants from Rihanna's Fenty x Puma Fall 2017 collection, featuring snaps along the sides for versatile transformation from long to short or slit styles

3.3.4. Material selection

The team selected experimental materials from recycled clothing products (Fig. 12) with different physical properties, such as stiffness, drape, and elasticity, and also selected materials with different colors, from dark, neutral, to light, to choose the right material for the design of the women's casual fashion collection.

The research team has chosen to use hidden zippers. The hidden zip has a special design that allows the zipper teeth and tape to be hidden beneath the fabric, creating a seamless and refined look. The zipper teeth are usually made of nylon, small and smooth to reduce friction, while the zipper tape is woven from polyester with slight elasticity for flexibility in use. This type of zipper is lightweight, available in various sizes and colors, making it suitable for evening gowns, dresses, dress pants, and lightweight jackets. With its smooth operation and non-bulky design, the hidden zip is an ideal choice for high-end fashion designs.

Fig. 12. Experimental materials

The zipper is strategically placed along the inseam running through the crotch, allowing the wearer to easily adjust and transform the garment's structure (Fig. 13). When fully unzipped, the pants can be seamlessly converted into a top, highlighting innovation and multifunctionality in design.

Fig. 13. The zipper is placed along the inseam running through the crotch

3.3.5. Style of product

The design style is oriented towards dynamism, youthfulness, and strong individuality, aligning with contemporary fashion trends and the current desire for self-expression among young people. It emphasizes a balance between aesthetics and functionality, allowing wearers to freely express their personalities while adapting to diverse situations. The silhouettes are modern yet practical, characterized by deconstructed

forms and flexible structures that reflect the fluid lifestyle of Generation Z. Inspired by recycled denim, the designs convey a sense of creativity and environmental awareness through the natural textures and tones of the material. This approach not only enhances visual appeal but also reinforces the concept of sustainable, transformative fashion-where innovation, versatility, and personal identity coexist harmoniously.

3.3.6. Concept development and design sketches

The moodboard, shown in Fig. 14, draws inspiration from recycled denim, visualizing a sustainable fashion narrative through the textures of worn fabrics.

Fig. 14. Moodboard

Inspired by recycled denim, the collection's sketches, as seen in Fig. 15, feature deconstructed designs that transform into versatile, multi-functional garments through innovative structural reconfiguration.

3.3.7. Selected design for prototype development

Based on the research above, we have chosen model 6, specifically the design shown in Fig. 15, for its high practicality and ease of execution, incorporating zippers for added functionality. We already have an old pair of jeans that can be recycled, so we will repurpose them for this project. Old denim is a readily available material, making it ideal for modifications, reuse, and product innovation.

Fig. 16. Selection pattern

a) Model 1 b) Model 2 e) Model 5 f) Model 6

c) Model 3 d) Model 4 g) Model 7

Fig. 15. Sketches

4. Results and Discussion

Building on the concept of developing multifunctional clothing from used garments, this research focuses on leveraging structural features and connection points of the product, while utilizing hidden zippers to join components. Fig. 17 presents an innovative product with the primary function of pants that can be transformed into an off-shoulder top, which is evidently the outcome of the design process. This novel transformable capability offers high technological applicability for similar products while maintaining strong market viability.

In terms of aesthetics, this design showcases uniqueness and creativity by repurposing original details such as pockets, seams, and zippers as distinctive accents. The natural fading and textured surface of denim add a bold, rugged style while reinforcing the concept of sustainable fashion. Functionally, the garment's transformable nature allows for versatility, enabling the wearer to switch between a jacket and pants effortlessly, offering multiple styling options for different occasions. The durable denim fabric, with its appropriate stretch, ensures comfort and long-lasting wear. With high practicality, this design not only maximizes usability but also promotes the growing trend of sustainable, innovative, and adaptable fashion.

The proposed design highlights the integration of form and function through a balance between creativity and practicality. By leveraging the structural properties of denim and the discrete functionality of hidden zippers, the design ensures a seamless transformation between garment states without compromising aesthetics. Furthermore, this approach promotes a sustainable production process by maximizing material usage and reducing fabric waste. The garment becomes not only a fashion statement but also a practical solution for modern lifestyles, meeting the demands of mobility, personalization, and conscious consumption. This direction contributes significantly to redefining the role of fashion in a circular economy, encouraging users to value longevity and adaptability in their wardrobe.

Fig. 17. Completed product

With these principles in mind, the research demonstrates a compelling case for transformable clothing as a key component in the future of sustainable fashion. However, alongside its notable advantages, the product also presents several limitations that should be considered. Firstly, due to the complexity of the transformable design and the use of hidden zippers in specific positions, the production process requires precise sewing techniques and high-level craftsmanship, making mass production challenging and potentially increasing manufacturing costs. Secondly, recycling and processing old denim fabric can be time-consuming, and inconsistencies in the material may lead to design errors. Additionally, as the product can transform from pants into a top, users need clear instructions on how to operate the transformation to avoid confusion or discomfort during wear. These limitations should be addressed in future design iterations to enhance user experience and improve the product's commercial viability.

5. Conclusion

In a context where sustainable fashion is increasingly becoming an inevitable trend, research on designing fashion products made from recycled materials not only has creative meaning but also actively contributes to reducing the fashion industry's waste and environmental impact. By leveraging flexible design methods, this research demonstrated the feasibility of developing multifunctional fashion products that adapt to changing user needs.

The research results confirm that using recycled materials not only helps optimize the product life cycle but also opens up new opportunities for innovation in the fashion industry. This contributes to promoting the trend of consuming sustainable fashion products, aiming to protect the environment.

References

[1] K. Bailey, A. Basu, and S. Sharma, The environmental impacts of fast fashion on water quality: a systematic review, Water, vol. 14, iss. 7, Mar. 2022, Art. no. 1073. http://doi.org/10.3390/w14071073

[2] I. van Herpen, Shift Souls - Haute Couture, Jan. 2019. Online. [Available]: https://www.irisvanherpen.com/haute-couture/shift-souls, Accessed on: Sep. 30, 2025.

[3] H. Chalayan, Spring/summer 2007 ready-to-wear collection: one hundred and eleven, Vogue, Paris Fashion Week, Oct. 2006. Online. [Available]: https://www.vogue.com/fashion-shows/spring-2007-ready-to-wear/hussein-chalayan, Accessed on: Sep. 30, 2025.

[4] V. Flander-Putrle, J. Francé, and P. Mozetič, Phytoplankton pigments reveal size structure and interannual variability of the coastal phytoplankton community (Adriatic Sea), Water, vol. 14, iss. 1, Dec. 2021, Art. no. 23. https://doi.org/10.3390/w14010023

[5] I. Nemeša, M. Pešić, N. Bukhonka, V. Božoki, and J. Šuščević, Transformable clothing to reduce pre- and post-consumer textile waste, in Proceedings 7th International Scientific Conference Contemporary Trends and Innovations in Textile Industry - CT&ITI 2024, IV Ecology & Sustainable Development, pp. 497–504. https://doi.org/10.5937/CT_ITI24055N

[6] M. Irovan, I. Tuturanu, S. Balan, and V. Labutina, Using the principles of transformation in the development of new design clothes-making for women, Annals of the University of Oradea, Fascicle of Textiles, Leatherwork, vol. 17, no. 2, pp. 75–80, 2016.

[7] M. Gong, Sustainable fashion design: transformable garments for versatility and longevity, M.A. thesis, Ryerson University, Toronto, ON, Canada, 2014.

[8] VnExpress, 12 Female Designers Influencing the Fashion World. (In Vietnamese: 12 NTK nữ ảnh hưởng làng mốt, 2020). [Online]. Available: https://vnexpress.net/12-ntk-nu-anh-huong-lang-mot-4102164.html

[9] Christian Dior AW 2022: The next era - bridging the gap between technology and fashion, Style Republik, Mar. 2022. [Online]. Available: https://style-republik.com/christian-dior-thu-dong-2022-the-next-era/, Accessed on: Sep. 30, 2025.

[10] J. Peter, Transformable fashion: the biggest sustainable clothing trend that never was, Fashion Studies Journal, Oct. 22, 2018. [Online]. Available: https://www.fashionstudiesjournal.org/longform/2018/9/15/transformable-fashion, Accessed on: Sep. 30, 2025.

[11] R. Faure, What is transformable clothing?, Off-Wrld Techwear, Sep. 2023. [Online]. Available: https://www.offwrld-techwear.com/, Accessed on: Sep. 30, 2025.

[12] D. Rosová, Exploring sustainable potential of transformable fashion, Bachelor's thesis (Smart and Sustainable Design), Rosová, Dominika, 2024. [Online]. Available: https://urn.fi/URN:NBN:fi:amk-2024052114055

[13] B. Wei and M. Ruppert-Stroescu, Sustainable fashion development: applying transformational design, in Proceedings of the International Textile & Apparel Association (ITAA) Annual Conference, no. 74, 2017.

[14] A. Rees and M. Rocca, STEPIC Innovations 2025, WGSN report, 2022. [Online]. Available: https://www.wgsn.com/en, Accessed on: Sep. 30, 2025.

[15] ThredUP, Resale Report 2023, Fashion Journal, vol. 10, 2023. [Online]. Available: https://www.thredup.com/resale, Accessed on: Sep. 30, 2025.

[16] Deloitte, The Deloitte Global 2021 Millennial, and Gen Z Survey, Deloitte, 2021. [Online]. Available: https://www.deloitte.com/global/en/pages/about-deloitte/articles/millennialsurvey.html, Accessed on: Sep. 30, 2025.

[17] A. Rees and M. Rocca, Future consumer 2025, WGSN, Futures, vol. 125, 2020. [Online]. Available: https://www.wgsn.com/en

[18] S. Li, How Gen Z uses social media to find fashion, Information, Communication & Society, vol. 25, no. 4, 2022.