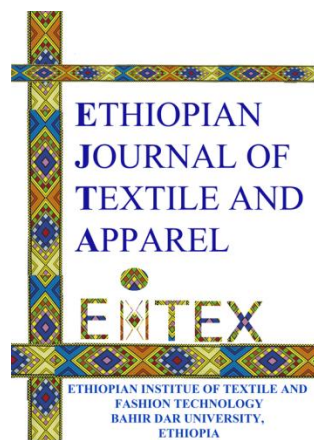




INNOVATION IN FOOTWEAR DESIGN AND CONSTRUCTION METHODS: FOCUS ON TRANSFORMABLE WOMEN'S FOOTWEAR

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ABSTRACT

Most people today have a footwear wardrobe with shoes for various activities and occasions. It is quite important that the footwear worn is appropriate for the activity being undertaken. Looking into different ways of meeting these need alongside environmental and economic sustainability consideration, this research work explores broad concept of resource efficient design (RED) to innovate a transformable female loafer. The design allows the footwear upper to be detached, making it possible to easily convert the footwear from a comfortable loafer into a fashionable court shoe and vice versa, reducing the need for multiple pairs of shoes and enhancing convenience for women on the go. This work was carried out using sustainable design concepts, manufacturing and the product evaluated through testing by potential users. The outcome demonstrates the potential for transformable footwear to redefine fashion utility by offering dual-purpose functionality without compromising on elegance or comfort. This innovation contributes to sustainable fashion by minimizing wardrobe excess and encouraging multifunctional design solutions in contemporary women's footwear.

Keywords: Transformable Footwear, Detachable Uppers, Female Loafers, Court Shoes and Sustainable Footwear

1. INTRODUCTION

The evolution of footwear design has increasingly focused on exploring both fashion and function, with transformability emerging as a key innovation strategy. In the context of women's fashion, where adaptability and aesthetic diversity are highly valued, transformable footwear presents a compelling solution to the limitations of traditional single-purpose shoes. Female consumers often require footwear that transitions seamlessly between formal, casual, and evening styles,

especially in urban settings where frequent outfit changes are impractical (Chun and Kang, 2020). Designing female loafers with detachable uppers allows one pair of shoes to fulfill multiple stylistic roles, thereby offering convenience, cost-effectiveness, and reduced environmental impact. This innovation reflects a broader change in the fashion industry toward modular design, which involves creating products with components that can be interchanged or reconfigured to meet different needs (Zhou and Han, 2020). In footwear, detachable elements such as uppers, straps, or covers

enable wearers to customize their look and function according to the occasion.

Moreover, this approach aligns with sustainability principles by promoting product longevity and reducing the need for multiple purchases. As Fletcher and Tham (2019) argue, extending the lifecycle of fashion products through multifunctionality and adaptability is essential to curbing the environmental toll of fast fashion. Transformable footwear, therefore, not only meets aesthetic and functional expectations but also contributes to a more responsible consumption model. Incorporating user-centered design principles is also critical to the success of such innovations. Aesthetic appeal, comfort, ease of transformation, and secure fastening mechanisms must all be carefully considered to ensure consumer satisfaction (Chittaro & Sioni, 2014). This study focuses on the conceptualization and design of female loafers with detachable uppers that allow innovation, transition, and evaluating the design's practicality, ergonomics, and user appeal through prototype development and feedback.

2. LITERATURE REVIEW

2.1 Historical Context and Recent Trends in Women's Footwear

Women's footwear has long been shaped by social expectations and evolving fashion norms. In recent years, consumer demand has shifted toward functionality without sacrificing elegance (Chun & Kang, 2020). In ancient civilizations such as Egypt, Greece, and Rome, women's shoes were often simple in design and made from natural materials like papyrus and leather. Footwear was closely associated with social class; for instance, in Ancient Rome, red-dyed shoes were reserved for patrician women (Semmelhack, 2016). During the Middle Ages and Renaissance, European women's footwear became more elaborate,

often characterized by pointed toes, platform soles, and decorative embellishments. The 17th and 18th centuries saw the rise of heeled shoes, particularly associated with court fashion in France, which emphasized refinement and social hierarchy (Rossi, 2000).

The 19th century brought about the industrial revolution, allowing for mass production of shoes and wider accessibility. The Victorian era popularized button boots and delicate slippers, often influenced by modesty and propriety. However, it was the 20th century that marked the most radical changes. The flapper culture of the 1920s favored T-strap and Mary Jane shoes for dancing, while the post-war era of the 1950s emphasized stiletto heels and femininity as part of the ideal housewife image (Riello & McNeil, 2006). In contemporary times, women's footwear trends have diversified to accommodate both aesthetic preferences and functionality. The 21st century has seen a shift towards comfort-driven designs, influenced by lifestyle changes and the rise of athleisure. Sneakers and flat shoes have gained popularity as women demand versatile footwear that aligns with active and professional lifestyles (Kawamura, 2021). Additionally, sustainability and ethical production have become significant trends in recent years. Consumers are increasingly aware of the environmental impact of fashion, prompting designers to explore eco-friendly materials, such as recycled plastics and plant-based leathers (Laitala et al., 2021). Furthermore, recent innovations include adaptable and transformable footwear, allowing wearers to customize or adapt shoes for different occasions. These designs cater to urban living and promote reduced consumption by offering multiple styles in a single product (Niinimäki & Hassi, 2011).

In conclusion, Designers have responded with footwear that integrates comfort

technologies and aesthetic customization. The inclusion of detachable components aligns with these trends, offering wearers control over their appearance while maintaining comfort and appropriateness across settings.

2.2 Adaptable and Transformable Design in Fashion

Adaptable and transformable design in fashion refers to garments and accessories that can be modified, reconfigured, or adjusted by the wearer to suit various occasions, functions, or personal preferences. This approach challenges traditional notions of static fashion by prioritizing versatility, sustainability, and user engagement. Adaptable design is an approach wherein products are created from separate, interchangeable components that can be assembled or disassembled to serve multiple functions. In fashion, this concept has been adopted to increase product versatility and reduce wardrobe redundancy (Zhou & Han, 2020). Within footwear, transformable design offers solutions for consumers who seek adaptability without compromising on style. adaptable footwear allows individuals to change styles according to different contexts, enhancing both fashion utility and sustainability.

2.3 Sustainability through Multifunctionality

The fashion industry is a major contributor to global environmental degradation. Consequently, sustainable design practices are increasingly being emphasized. Multifunctional products that serve multiple purposes help reduce consumption and waste (Fletcher & Tham, 2019). Transformable footwear not only enhances the value proposition of fashion items but also contributes to sustainable consumption by minimizing the need for multiple pairs of

shoes for different occasions. Multifunctionality in design refers to the ability of a single product to perform multiple roles or adapt to various uses. Within the context of sustainable fashion and product development, multifunctionality serves as a strategic approach to reduce environmental impacts by extending product lifespans, minimizing resource use, and encouraging mindful consumption.

One of the key environmental benefits of multifunctional design is its contribution to reducing overproduction and overconsumption—two major challenges in the global fashion system. By encouraging consumers to own fewer, but more versatile items, multifunctional products can lead to a significant reduction in carbon footprint, water usage, and landfill contributions (Fletcher & Tham, 2019). According to Laitala, Klepp, and Henry (2021), increasing the number of wears and the adaptability of footwear is among the most effective strategies for reducing the environmental impacts associated with leather. Moreover, multifunctionality supports a circular economy model, where durability and reusability are prioritized over disposability. Products that can adapt to different user needs, life stages, or occasions inherently promote longevity and emotional attachment, which are essential aspects of sustainable consumption (Chapman, 2005). Multifunctional items often foster a stronger relationship between users and their possessions, encouraging care, repair, and long-term use. Technological advancements have also contributed to the growth of multifunctional design. The exploration of change components, smart footwear, and digital customization tools allows designers to create flexible products that accommodate user preferences and changing trends (Niinimäki & Hassi, 2011). These innovations further empower consumers to

participate in sustainable practices through informed and conscious wardrobe choices.

In summary, multifunctionality is a vital design strategy that aligns with the principles of sustainability by reducing material usage, extending product life, and fostering responsible consumption behaviors. As environmental concerns continue to shape consumer expectations, multifunctional design represents a forward-thinking solution that blends creativity with sustainability.

3. METHODOLOGY

The research and design methodology employed in this study combines qualitative user-centered approaches with practical experimentation in footwear prototyping. The design process followed the Double Diamond model, which includes phases of Discover, Define, Develop, and Deliver, to ensure that both user needs and technical feasibility are addressed. The Double Diamond Model is a design process framework developed by the UK Design Council in 2005. It helps designers and problem solvers navigate the creative process through the four phrases, organized into two (2) “diamonds” representing divergent and convergent thinking (see figure 1).

In addition, the semi-structured interviews and surveys were conducted with 30 participants aged 30-60 to evaluate the prototype.



Figure 1: Double Diamond Model. Design process framework developed by the UK Design Council (2005)

3.1 Concept Development

The design was generated from a textile material (see Figure 2) and the sketches (see Figure 3-6) were developed using ideation techniques and visual brainstorming. The Concepts were evaluated for their ability to meet criteria such as design simplicity, ease of assembly/disassembly, and aesthetic appeal to visualize the interchangeable components.

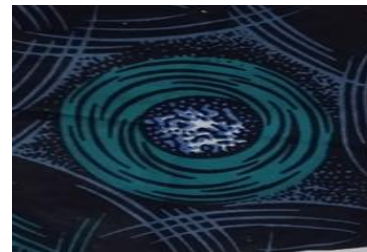


Figure 2: Textile printed fabric (scrap) for Extraction of Design Development

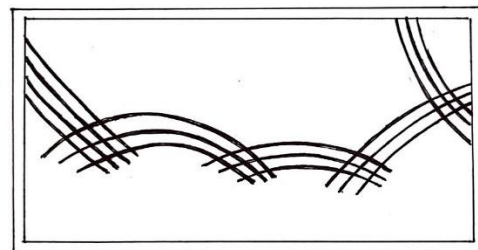


Figure 3: Extracted Design



Figure 4: Developed complete Venetian fashionable Footwear



Figure 5: Detached Venetian Fashionable Footwear



Figure 6: the selected detachable footwear sketches

3.2 Materials Selection and Prototype Construction

Material selection focused on lightweight, breathable, and durable, textiles printed patterns suitable for the extraction of design for both loafers and court shoes. Upper components were made from vegetable tanned leather (Black and Grey), while soles were constructed from Ethylene-Vinyl Acetate (EVA). Fastening mechanisms, including hidden velcro and press buttons, were tested for reliability and ease of use. Pictorials for the key materials and accessories used for this work are shown in figure 7-11



Figure 7: vegetable tanned leather (black)



Figure 8: Vegetable tanned leather (grey)



Figure 9: Velcro



Figure 10: Press Button



Figure 11: Ethylene-Vinyl Acetate (EVA) soling material

3.3 Direct Stuck or Cemented Construction Method in Footwear

Stuck or Cemented construction method was used to develop the prototype. It is a popular method used in footwear manufacturing, known for its durability, flexibility, and streamlined appearance. This construction technique involves adhering the shoe upper directly to the outsole using specialized adhesives, creating a seamless bond that provides both structural integrity and aesthetic appeal (Wilcox, 2019).

3.4 Working Pattern

The working pattern that carries the folding allowance (5mm), underlay allowance (10mm) and lasting allowance (20mm) are shown in Figure11.

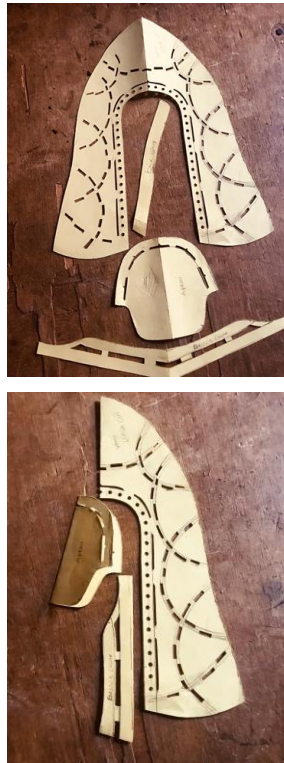


Figure 12: Cut out pattern from the cardboard paper

3.5 Lasting.

Lasting operation is a crucial step in the manufacturing process of bespoke footwear, where the upper components of the shoe where stretched and shaped over the shoe

last to achieve the desired fit and silhouette. This operation was carefully carried out as shown in Figure 12.



Figure 13: Production processes

3.6 Footwear Prototyping, Testing and User Feedback

Development and manufacturing products such as footwear can be facilitated by using prototyping techniques. Footwear prototyping helps to reduce the bottom-line

cost of research and development, but the prototyping itself is a costly feature and prototype design, and production can add considerable expense to a project (Tagang, 2014).



Figure 14: Different stages on how the footwear can be detached and worn

4. RESULTS AND DISCUSSION

4.1 Data Collection and User Needs Assessment

To understand the preferences, challenges, and expectations of female footwear users, semi-structured interviews and surveys were

conducted with 30 participants aged 30–60, out of only 23 respondents were selected based on their interest in fashion and functionality, and their daily engagement in environments requiring style transitions, such as office settings, social outings, and commutes. Data gathered helped in identifying the most desired features in transformable footwear: comfort, secure fit, ease of transition, and aesthetic versatility.

4.2 Prototype Testing and User Feedback

A prototype was produced and tested by a subset of 23 participants who evaluated the footwear in which the participants rated the prototypes on comfort, aesthetic satisfaction, ease of upper replacement, and overall functionality. Feedback was analyzed to refine fastening positions and improve ergonomic design. Ethical considerations informed consent was obtained from all participants, and responses were anonymized to ensure privacy. The study adhered to ethical research practices as outlined by institutional guidelines for design-based research.

4.3 Findings

The results of the user-centered design approach and prototype testing revealed significant support for the concept of transformable female loafers with detachable uppers. The main findings are categorized under functionality, user satisfaction, and design improvement areas.

- i. Participants reported high satisfaction with the functionality of the detachable upper design. The Velcro press button detaching system proved to be the most preferred fastening mechanism due to its ease of use and secure attachment. Twenty-three (23) out of thirty (30) participants were able to switch from

loafer to court shoe configuration within 30 seconds, indicating a high degree of usability.

- ii. In terms of comfort, 76.6% of participants found the prototypes ergonomically supportive for day-long wear. The use of breathable inner linings and flexible sole material contributed positively to comfort ratings. Aesthetically, users appreciated the dual-style concept, highlighting the versatility of a single shoe adapting to multiple outfits and occasions.
- iii. Participants also acknowledged the economic and environmental value of the design. The ability to reduce the number of shoes purchased and stored was seen as both a cost-saving and space-saving innovation. Some participants (70%) expressed interest in buying similar multifunctional products, citing sustainability and utility as deciding factors.
- iv. These findings align with literature supporting changed fashion as a means to achieve sustainability, functionality, and personalization. The project validates that consumers are open to transformable footwear innovations, particularly when the design addresses real-world needs like convenience and style transition.

5. CONCLUSION

The development of transformable female loafers with detachable uppers represents a significant stride in footwear innovation. The design successfully merges aesthetic versatility with practical functionality, meeting the needs of modern consumers who seek adaptable fashion solutions. Through detailed research, concept development, and iterative prototyping, the study has demonstrated that detachable footwear can enhance user satisfaction, promote sustainable consumption, and offer economic benefits.

6. RECOMMENDATIONS

- i. Continued experimentation with new closure technologies could improve both the security and aesthetics of detachable components.
- ii. Offering users, the ability to purchase multiple upper styles separately could enhance customization and market reach
- iii. Positioning transformable footwear as a sustainable product can appeal to eco-conscious consumers
- iv. Future designs should explore biodegradable and recycled materials to strengthen the product's sustainability profile.
- v. Market testing in different demographic groups will help assess the broader commercial potential of the design

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