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# Circular Thinking in Fashion Accessories Design: From Material Innovation to Product Lifecycle

Supawadee Juysukha<sup>1</sup> and Chanoknart Mayusoh<sup>2</sup>

<sup>1,2,3</sup>Department of Fashion Design, Faculty of Fine and Applied Arts Suan Sunandha Rajabhat University, Thailand

E-mail: <sup>1</sup> Supawadee.ju@ssru.ac.th, <sup>2</sup> chanoknart.ma@ssru.ac.th

## Abstract.

The fashion industry is increasingly challenged to adopt sustainable practices; however, discussions on circular economy have predominantly focused on apparel, leaving fashion accessories relatively underexplored. Despite their smaller scale, fashion accessories involve complex material combinations and short product lifecycles, which present significant sustainability challenges. This study investigates how circular thinking can be systematically integrated into fashion accessories design by examining material innovation and product lifecycle strategies.

The research aims to: (1) analyze circular design principles as applied to fashion accessories, (2) examine material innovations suitable for circular accessories, including biomaterials and recycled materials, and (3) propose a comprehensive framework to support lifecycle-based circular design in accessories. A qualitative design research approach was employed, combining a systematic literature review with comparative case studies of contemporary fashion accessories brands that actively implement circular strategies. The selected cases were analyzed through a lifecycle lens, encompassing material sourcing, design development, production, use, and end-of-life stages.

The findings reveal that effective circular accessories design relies on early-stage material selection, mono-material or modular construction, and design strategies that enhance durability, repairability, and emotional attachment. However, current practices often address isolated stages of the lifecycle rather than adopting an integrated approach. In response, this study proposes a Circular Accessories Design Framework that synthesizes material innovation with lifecycle thinking to guide designers in making informed and sustainable design decisions.

This research contributes to the expanding discourse on circular design by providing an accessories-specific framework that bridges theory and design practice. The proposed framework offers practical implications for designers, educators, and industry stakeholders seeking to advance sustainable innovation within the fashion accessories sector.

**Keywords:** Circular design, circular economy, fashion accessories, product lifecycle, sustainable materials

## 1. Introduction

The fashion industry has become one of the most resource-intensive and environmentally impactful global industries, prompting increasing academic, industrial, and policy driven attention toward sustainability. In recent years, the concept of the circular economy has emerged as a critical framework for addressing environmental challenges by shifting from a linear “take–make–dispose” model to regenerative systems that emphasize material efficiency, longevity, and closed loop processes. While circular economy principles have been widely discussed and applied within apparel design and production, fashion accessories remain a comparatively underexplored domain within sustainability discourse.

Fashion accessories including bags, footwear, jewelry, and small leather goods play a significant role in fashion consumption, brand identity, and personal expression. Despite their smaller scale compared to garments, accessories often involve complex material compositions, combining metals, plastics, textiles, coatings, and hardware. These material complexities, along with trend-driven consumption patterns and limited repair or recycling options, present substantial challenges for circular design implementation. As a result, many accessories continue to follow linear production and disposal pathways, contributing to resource depletion and environmental waste.

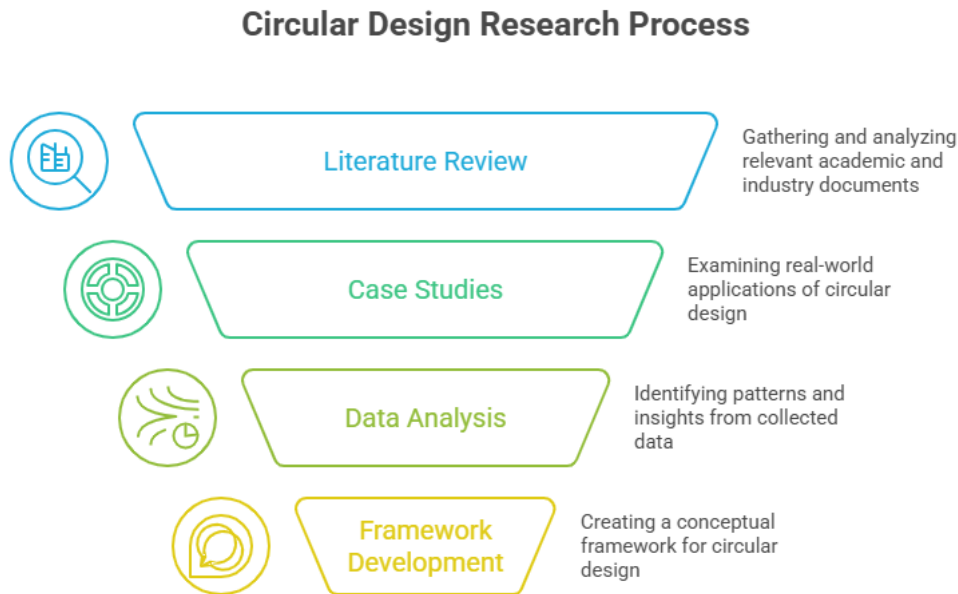
Existing research on circular fashion design has primarily focused on apparel related strategies such as textile recycling, modular clothing, and extended garment lifecycles. However, these approaches cannot be directly transferred to accessories without critical adaptation, due to differences in function, materiality, durability expectations, and user interaction. Consequently, there is a lack of design oriented frameworks that specifically address the unique characteristics and lifecycle stages of fashion accessories within a circular economy context.

This study responds to this research gap by investigating how circular thinking can be systematically integrated into fashion accessories design, from material innovation to product lifecycle planning. The research aims to analyze circular design principles as they apply to accessories, examine emerging biomaterials and recycled materials suitable for accessories production, and propose a comprehensive lifecycle-based framework to support circular design decision-making. By focusing on fashion accessories as a distinct design category, this research seeks to contribute both theoretically and practically to the advancement of circular design strategies within the broader fashion industry.

### 1.1 Research Objective

1. To analyze circular design principles applied to fashion accessories
2. To investigate material innovations suitable for circular accessories
3. To propose a lifecycle-based circular design framework

Figure 1: Conceptual framework



## 2. Literature review

### Circular Economy and Design

The concept of the circular economy has gained significant prominence as a response to the environmental and social limitations of the traditional linear economic model. According to the Ellen MacArthur Foundation, a circular economy is defined as an industrial system that is restorative and regenerative by design, aiming to maintain the value of products, materials, and resources for as long as possible while minimizing waste generation. Similarly, the European Union frames the circular economy as a key strategy for sustainable development, emphasizing resource efficiency, waste reduction, and closed-loop material cycles across production and consumption systems.

Within the field of design, circular economy principles have been translated into the concept of circular design, which emphasizes systemic thinking and lifecycle awareness. Circular design extends beyond product aesthetics and functionality to consider material sourcing, production processes, user behavior, and end-of-life scenarios. Core principles commonly associated with circular design include reducing material and energy use, reusing products and components, recycling materials, and regenerating natural systems. These principles encourage designers to shift their focus from short-term product lifespans toward long-term value creation and environmental responsibility.

Design scholars argue that circular design requires a fundamental rethinking of the designer's role, positioning designers as facilitators of sustainable systems rather than solely creators of objects. This perspective highlights the importance of early-stage design decisions, particularly material selection and construction methods, in determining a product's environmental impact across its lifecycle. While circular design frameworks have been developed for various industries, their application within specific design domains—such as fashion accessories—remains limited and requires further investigation.

## **Circular Design in Fashion**

Within the fashion industry, sustainability discourse has evolved from a focus on ethical production and environmental impact reduction toward more holistic circular fashion models. Sustainable fashion is often associated with practices such as using eco-friendly materials, reducing water and energy consumption, and improving labor conditions. In contrast, circular fashion emphasizes systemic change by redesigning products and business models to eliminate waste and enable continuous material circulation.

Existing research on circular fashion has predominantly centered on apparel design, addressing strategies such as garment durability, modular clothing, textile recycling, and clothing rental or resale systems. Several circular models have been proposed for apparel, including design for longevity, design for disassembly, and closed-loop textile recycling. These models demonstrate the potential of circular thinking to reduce the environmental footprint of clothing while extending product lifespans.

However, the direct application of these apparel-focused models to fashion accessories presents notable limitations. Accessories differ significantly from garments in terms of material composition, functional requirements, and user interaction. While apparel often relies primarily on textile materials, accessories typically combine multiple materials—such as leather, metals, plastics, and hardware—making recycling and disassembly more complex. Furthermore, accessories are often valued for their durability and symbolic significance, which complicates conventional circular strategies such as rapid recycling or material substitution. As a result, existing circular fashion frameworks inadequately address the specific design challenges associated with fashion accessories, indicating a clear research gap within the literature.

## **Fashion Accessories Design and Sustainability**

Fashion accessories occupy a distinct position within the fashion system, functioning not only as functional objects but also as carriers of identity, status, and emotional value. Accessories such as bags, shoes, belts, and jewelry often have longer usage periods than garments and are frequently associated with higher perceived value. Despite this potential for longevity, accessories remain underexamined within sustainability and circular design research.

One defining characteristic of fashion accessories is their complex material structure. Accessories frequently incorporate mixed materials, including natural and synthetic components, adhesives, coatings, and metal hardware. This material complexity poses significant challenges for sustainable design, particularly in relation to recycling and end-of-life processing. Unlike single-material products, accessories are often difficult to disassemble, leading to disposal rather than material recovery.

Durability is another critical factor in accessories design. While durability is commonly viewed as a positive sustainability attribute, it can also create tension with circularity if products are designed for permanence without considering repairability or material recovery. Additionally, emotional value plays a crucial role in accessories consumption. Accessories are often purchased as expressions of personal identity or cultural meaning, which can enhance emotional attachment and prolonged use. However, design strategies that intentionally foster emotional durability are not yet systematically integrated into circular design frameworks for accessories.

These characteristics suggest that sustainability in fashion accessories design cannot rely solely on material substitution or recycling strategies. Instead, it requires a holistic approach that integrates material innovation, lifecycle thinking, and user-centered design principles.

### **Material Innovation in Circular Fashion**

Material innovation is a central component of circular fashion design, particularly in the context of fashion accessories where material choice significantly influences product performance, aesthetics, and environmental impact. Recent research highlights the growing use of biomaterials as alternatives to conventional leather and synthetic materials. Plant-based leather substitutes derived from materials such as pineapple leaves, cactus fibers, mushroom mycelium, and apple waste have gained attention for their reduced reliance on animal products and fossil fuels. Similarly, bio-resins and natural composites offer opportunities to replace petroleum-based plastics in accessories components.

In addition to biomaterials, recycled materials play a crucial role in circular fashion strategies. Recycled metals, plastics, and textile waste are increasingly used in accessories design to reduce raw material extraction and divert waste from landfills. Recycled metals, in particular, are well-suited to accessories due to their durability and recyclability, while recycled plastics offer lightweight and versatile design possibilities.

However, the adoption of innovative materials in accessories design must be critically evaluated in terms of material performance, aesthetic quality, and lifecycle impact. Factors such as durability, aging behavior, repairability, and recyclability significantly influence the long-term sustainability of accessories products. Moreover, the aesthetic and tactile qualities of materials are essential in maintaining consumer acceptance and emotional attachment. Therefore, material innovation in circular fashion accessories must balance environmental benefits with functional and experiential considerations.

In summary, existing literature highlights the importance of circular economy principles, material innovation, and lifecycle thinking in sustainable design, yet reveals a lack of integrated, accessories-specific frameworks. This gap underscores the need for further research into circular thinking in fashion accessories design, particularly approaches that connect material innovation with holistic product lifecycle strategies.

## **3. Methodology**

### **Research Approach**

This study adopts a qualitative design research approach to explore how circular thinking can be integrated into fashion accessories design. Qualitative methods are particularly appropriate for design-oriented research, as they allow for in-depth examination of design processes, material choices, and conceptual frameworks rather than quantitative measurement alone. The research is exploratory in nature, aiming to investigate emerging practices and identify patterns within circular fashion accessories design, while also analytical in its intent to critically examine existing design strategies through a lifecycle perspective.

By combining theoretical inquiry with practice-based analysis, this approach supports a comprehensive understanding of circular design principles as they are interpreted and implemented by designers and brands. The qualitative design research framework enables the synthesis of diverse sources of information, including academic literature, design

documentation, and visual material, to generate insights that inform the development of a conceptual design framework.

### **Data Collection**

Data were collected through two primary methods: a systematic literature review and qualitative case studies. The literature review focused on peer-reviewed academic journals, industry reports, and policy documents related to circular economy, circular design, sustainable fashion, and material innovation. Particular attention was given to European sources and frameworks, reflecting the regional relevance of circular economy initiatives.

In addition, case studies of contemporary fashion accessories brands and designers were conducted to examine real-world applications of circular design principles. A European focus was prioritized due to the region's leadership in circular economy policy and sustainable design practices. Data sources for the case studies included brand publications, design process descriptions, sustainability reports, interviews, and visual documentation of products.

### **Case Selection Criteria**

Case studies were selected based on clearly defined criteria to ensure relevance and analytical consistency. First, selected brands or designers demonstrated the use of circular or sustainable materials, such as biomaterials or recycled materials, within their accessories collections. Second, the cases exhibited lifecycle-oriented design strategies, including considerations for durability, repairability, modularity, or end-of-life solutions. Third, the accessibility and transparency of design and production information were essential, allowing for meaningful analysis of material choices and lifecycle approaches.

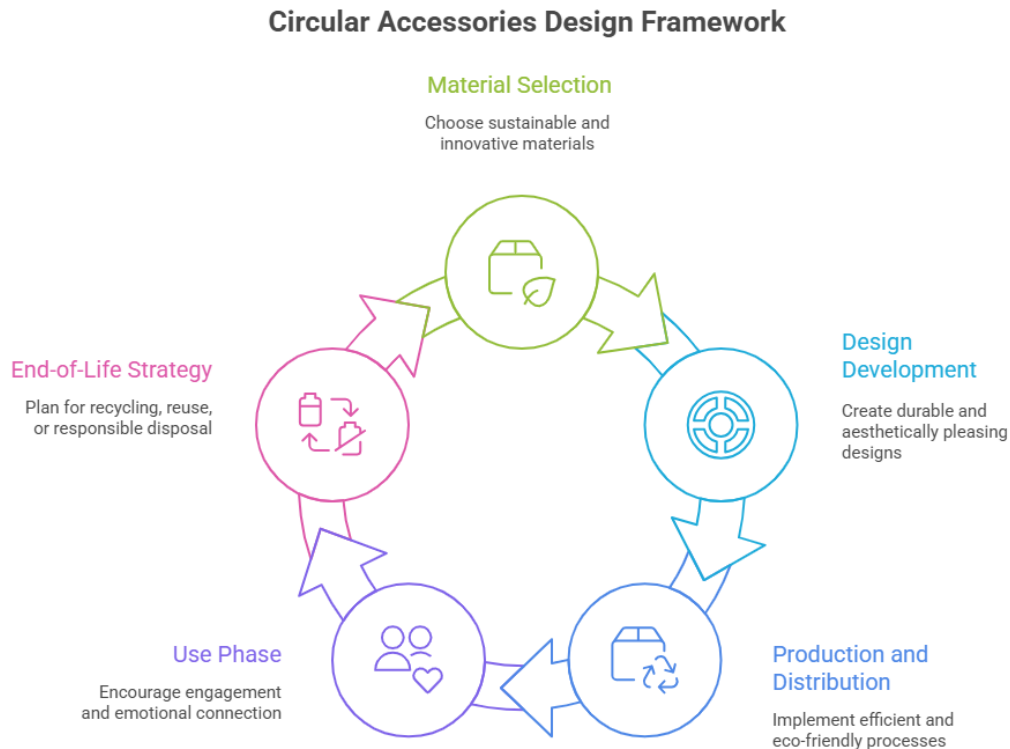
These criteria ensured that the selected cases provided sufficient depth and comparability for evaluating circular design practices in fashion accessories.

### **Data Analysis**

Data analysis was conducted using a lifecycle-based analytical framework, examining each case across key stages of the product lifecycle: material sourcing, design and production, use phase, and end-of-life strategies. This lifecycle analysis enabled the identification of how circular thinking is embedded at different stages of the design process.

In addition, a comparative design analysis was employed to identify similarities, differences, and recurring patterns among the case studies. By comparing material choices, construction methods, and lifecycle strategies, the study synthesized key insights that informed the development of the proposed Circular Accessories Design Framework. This dual analytical approach supports a systematic and design oriented interpretation of circular practices within the fashion accessories sector.

Figure 2: Circular Accessories Design Framework



## 4. Results

This study set out to investigate how circular thinking can be systematically integrated into fashion accessories design by examining material innovation and product lifecycle strategies. While circular economy discourse within the fashion industry has largely focused on apparel, this research highlights the distinct characteristics and challenges of fashion accessories, including complex material compositions, durability expectations, and strong emotional value. These factors necessitate accessories-specific approaches to circular design rather than direct adaptation of existing apparel-based models.

Through a qualitative design research methodology combining literature review and European-focused case study analysis, the study identified key circular strategies currently employed in fashion accessories design. The findings indicate that material innovation particularly the use of biomaterials and recycled materials serves as a primary entry point for circular practices. Design strategies emphasizing durability, craftsmanship, and repair also play a crucial role in extending product lifespan. However, the analysis reveals that many existing practices address isolated stages of the product lifecycle, most notably material sourcing, while neglecting a holistic integration of use-phase engagement and end-of-life planning.

In response to these findings, this research proposed a Circular Accessories Design Framework that integrates lifecycle thinking across five interconnected stages: material selection, design development, production and distribution, use phase, and end-of-life strategy. By positioning designers as central agents in shaping circular outcomes, the framework emphasizes the importance of early-stage design decisions and systemic thinking. It offers a

structured approach to embedding circular economy principles into accessories design practice while maintaining aesthetic quality and functional performance.

## 5. Conclusion

The study contributes to the growing body of circular design literature by providing an accessories-specific framework that bridges theoretical discourse and design practice. From an educational perspective, the framework offers a valuable tool for integrating sustainability and lifecycle thinking into fashion accessories design curricula. For industry practitioners, it provides practical guidance for developing more circular products in alignment with European sustainability agendas and evolving consumer expectations.

Despite its contributions, the study has limitations. The qualitative nature of the research and the focus on European case studies may limit the generalizability of the findings. Future research could expand this framework through quantitative lifecycle assessments, user-centered studies on emotional durability, and exploration of emerging technologies and materials. Nonetheless, this research underscores the critical role of circular thinking in advancing sustainable innovation within the fashion accessories sector and provides a foundation for continued academic and practical development in this field.

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