

Modular Fashion: Sustainable Potential and Challenges for the Industry

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Introduction

With increasing discussion about rethinking and redesigning the fashion system toward a transition to a circular economy, incorporating modularity in fashion design is gaining attention as a creative and promising possibility (Fletcher & Grose, 2012; Vaid, 2021; Sahimaa et al., 2023). Modular design in fashion not only could bring a sustainable potential for extending garment longevity through versatility (Fletcher & Grose, 2012; Gwilt & Pal, 2017) but also may offer the possibility of a systematic transition from complete garments to detachable clothing parts, thus, meeting diverse needs while reducing consumption (Zhang et al., 2024). Modular garments are clothing assemblages composed of individual and detachable garment modules (e.g., sleeves, main bodies and hoods) that are connected through closure interfaces (e.g., zips, buttons and ribbons). To accommodate a systematic development of modular garments, modular fashion (MF) is proposed accordingly as a business model featuring modularity throughout all garment lifecycles (Zhang et al., 2024).

Due to the modular structure, individual garment modules can be washed and repaired separately, adapted for different occasions and even mixed and matched or reused (Chen & Li, 2018; Fletcher & Grose, 2012). Thus, MF could potentially reduce washing frequency, simplify repairs through module replacement, and meet consumers' evolving needs of being fashionable and on-trend through mixing and matching individual components (Fletcher & Grose, 2012; Gwilt & Pal, 2017; Zhang et al., 2024). Therefore, MF is seen as a sustainable strategy that could potentially extend garments' longevity and reduce overall consumption by encouraging customers to consume and dress in a modular manner (Zhang et al., 2024). Additionally, it is even indicated as "the next big

thing" to reshape the fashion industry toward a sustainable fashion future (Vaid, 2021).

Yet, it is still unknown to what extent MF can be an effective sustainable initiative and/or alternative and how it may affect the industry's future. Maldini and Balkenende (2017) suggest the need for verifying sustainable initiatives like MF to move the research toward the empirical level, such as studying long-term buying behaviours of consumers engaging with modular dressing manners. While it is critical, it is premature and challenging to validate such behaviours, given that MF is not yet widely adopted. Meanwhile, as a potential pathway for systematic transition, modularity is more than a shift in consumer purchase decisions and behaviour. Such a radical change necessitates a fundamental mindset shift among all other actors in the fashion industry, from designers, suppliers and manufacturers to retailers (Seixas et al., 2021). This crucial perspective is lacking and addressed within this research, which focuses on the industry's perceptions to explore the sustainable potential and industry challenges of MF. This study aims to provide novel insights into the systemic challenges and opportunities of MF through the lens of industry, contributing to a deeper understanding of MF and its broader implications for shaping a sustainable fashion system.

Methods

This study is exploratory as it seeks to understand industry experts' perceptions of MF in terms of sustainable potential and especially challenges and barriers to its adoption. This is an ongoing project, which study started in April 2024 and aims to purposively recruit twelve experts online, each with a minimum of two years of work experience in the fashion industry,

to conduct in-depth semi-structured interviews. A pre-prepared interview guide is used, with questions developed around themes identified from the literatures, including complexity and sustainability. To ensure a shared understanding of MF between each interviewee and the researcher, Figure 1 is presented for explanation before any questions are asked. All interviews are audio recorded, transcribed and analysed using thematic analysis on NVivo. Initial *a priori* codes were created. Discrepancies were discussed and a coding protocol established that allowed themes to be categorized.

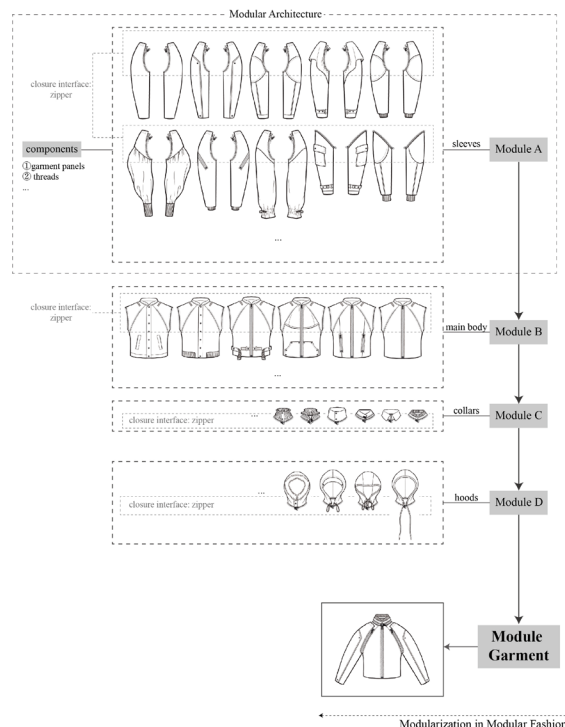


Figure 1. Image used in the semi-structured interview to provide a visual explanation of MF. (Source: Zhang et al., 2024, p.6).

So far, six semi-structured interviews, each lasting a minimum of 50 minutes, have been conducted. Table 1 is a summary of the data collection and showcases the diverse expertise of the participants, including fashion designers with experience in modular design, manufacturers, and retailers.

| Participant ID | Occupation | Expertise |
|----------------|--|---|
| P1 | Fashion designer | <i>Individual designer with 5+ years of industry experience & MF experience</i> |
| P2 | Fashion designer | <i>Employed at a well-known fashion company with 2+ industry experience & MF experience</i> |
| P3 | Operation Direction | <i>with 25+ years of industry experience</i> |
| P4 | CEO of a sustainable fashion consultancy | <i>with 20+ years of industry experience in manufacturing</i> |
| P5 | Academic | <i>with 3+ years of industry experience in design and retailing</i> |
| P6 | Academic | <i>with 30+ years of industry experience from design, retailing to manufacturing</i> |

Table 1. Summary of Participants.

Findings

Sustainable Potential

When asked to provide their initial impression after being shown Figure 1 and explaining the idea of MF, interviewees indicated that “it's a brilliant idea...if it can be done. I think the idea [...] being able to [...] create, um, something that's unique to the individual and even beyond doing that, being sustainable” (P5). Overall, data from these six semi-structured interviews suggest that MF is a creative, interesting and customisable novel concept that has sustainable potential through its modular structure. This early finding aligns with the theoretical assumptions regarding the sustainable potential of MF because of its interchangeability.

Industrial Challenges

Although data highlight the sustainable potential of MF and its commercial value to varying degrees, it also reveals multiple challenges in its industrial adoption. These are mainly caused by the complexity of modular design, a common concern expressed by all six interviewees.

Designers feel that modular design conflicts with the creative experiment process, emphasising that “we expect designers to experiment and to identify through play [...] not pre-planning [...] if you want to conceptualise the modularity [...] it needs rules that have to follow in the design process” (P1). Manufacturers indicate that it brings challenges of ensuring compatibility across garment modules, which requires a longer developing process and more sewing time “to (be) 100% sure that what you’ve put together is going to work [...] and look really good at every size” (P3). Retailers think MF could be an interesting marketing strategy, but it is risky due to the unclear consumer attitudes and higher costs compared to conventional clothing.

The initial findings reveal that these challenges primarily fall into three areas: early adopters (Table 2a), the design stage (Table 2b), and the production stage (Table 2c). This reflects the inherent complexity involved in designing modular systems (Baldwin & Clark, 2000).

| Angle of View: Early Adopter (mainly due to the complexity of MF) | |
|--|---|
| Theme | Explanation (partial) |
| Market uncertainty & consumer engagement | <ul style="list-style-type: none"> uncertainty about market acceptance customers might get bored with the modular dressing one day |
| Insufficient motivation | <ul style="list-style-type: none"> lack of awareness from brands (benefits of MF) market pressure is not huge enough (consumer still buy anyway) |
| Higher costs and risk of profit reduction | <ul style="list-style-type: none"> interests prefer to protect profits over sustainability higher cost of developing and manufacturing (complex and longer process) |

Table 2a: Emerging themes concerning early adopters.

| Angle of View: Design (more challenging and complex design) | | |
|--|--|--|
| Theme | Explanation (partial) | |
| Creative design with an engineering mindset | <ul style="list-style-type: none"> Conflict: design experimentation & pre-planning (MF) precise planning, measurement and design for compatibility(pattern) to design thoughtful, effortlessly and very beautiful | |
| Initial Design Stage | Segmentation and garment module design | <ul style="list-style-type: none"> category and design garment modules reasonably (quantity and silhouette, cost) design garment module in a flattering shape and size |
| | Optimised design in closure interface | <ul style="list-style-type: none"> hard to make perfect choice for closure interface |
| Mid-Design Stage | Complexity in material sourcing and compatibility | <ul style="list-style-type: none"> suitable materials to be able be puzzled together complexity in the fabric shading when puzzling |
| | Versatile and compatible design | <ul style="list-style-type: none"> create versatile pieces across collections |
| | Increased complexity in team communication | <ul style="list-style-type: none"> add complexity for team communication |
| | Balancing creativity, wearability and inclusivity | <ul style="list-style-type: none"> difficult to be wearability, practicality and comfort & playfulness build modular fashion system with inclusive size standardise length help anticipate size but don't guarantee fit |
| Later Design Stage | Creativity constraints post-system setup | <ul style="list-style-type: none"> restrict designers' creativity after the system is built |

Table 2b: Emerging themes concerning design.

| Angle of View: Production (is able to produce but might reluctance to alter) | |
|---|--|
| Theme | Explanation (partial) |
| Higer operational costs | <ul style="list-style-type: none"> a risk of upscaling and scaling might cost more than profit if make change |
| Greater skills and effort required | <ul style="list-style-type: none"> more manufacturing skills needed too much extra work dealing with complex pattern and sizes to ensure right fit |
| Reluctance to change (status quo bias) | <ul style="list-style-type: none"> might resist change to maintain contracts and suit designers |
| insecurity about employability | <ul style="list-style-type: none"> conflict between less production and employability |

Table 2c: Emerging themes concerning production.

Conclusions

This study explores the sustainable potential and challenges of MF from the viewpoints of industry experts through empirical data collected by semi-structured interviews. By moving the discussion toward the empirical level, it extends existing research on MF. Early findings reveal that despite recognition of its sustainable potential, MF adoption faces some hurdles, mainly due to the complexity of modular design itself. Challenges have been identified in three key areas: early adopters, the design stage, and the production stage. At present, the findings are based on only six semi-structured interviews. It suggests that fashion designers take a significant role in MF development throughout all stages. Future research could explore consumer perceptions to encourage early adoption and explore identified challenges to address the complexities of modular design in fashion.

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