

SUSTAINABLE INNOVATION: INTEGRATING TRADITIONAL CHINESE EMBROIDERY INTO ECO-FRIENDLY FASHION

ZHANG, Y.^{1*} – RUSLI, R. D.¹

¹ College of Art and Design, Universiti Teknologi MARA, Selangor, Malaysia.

**Corresponding author
e-mail: yaqiancheung[at]foxmail.com*

(Received 03rd August 2026; revised 29th September 2026; accepted 09th October 2026)

Abstract. This study examines how traditional Chinese embroidery can contribute to sustainable fashion through cultural preservation, design innovation, and contemporary craft adaptation. Using a qualitative multiple-case approach, the research analyses three cases: Ruby Fang's sustainable couture, Zhong Ming's digitally mediated Shu embroidery, and Kartik Research's artisan collaboration model. Data were drawn from literature, visual materials, publicly available case documentation, and secondary institutional sources, and interpreted through thematic analysis and cross-case triangulation. Findings identify three pathways for integrating traditional craftsmanship into contemporary fashion. First, motif translation preserves cultural narratives and enhances the symbolic and emotional value of garments. Second, digital technologies support pattern exploration, documentation, and heritage communication, while remaining dependent on artisans' tacit knowledge and practical skills. Third, artisan collaboration strengthens cultural visibility and market differentiation, although its wider economic benefits remain unverified. Cultural sustainability emerges as the most clearly supported contribution across the cases. However, the available evidence does not establish reductions in environmental impact or measurable improvements in artisan livelihoods. Such claims require independent production records, lifecycle assessments, and socioeconomic data. The study offers a cautious framework for understanding embroidery as a culturally embedded design practice and highlights directions for future research into its environmental and social outcomes.

Keywords: *Chinese embroidery, sustainable fashion, cultural sustainability, traditional craftsmanship, design innovation*

Introduction

With its long history and rich cultural heritage, traditional Chinese embroidery offers a unique paradigm for innovation within modern sustainable fashion. Driven by the fast fashion model, the contemporary global fashion industry has become notoriously resource-intensive, generating massive textile waste and severe environmental degradation (Niinimäki et al., 2020; Fletcher, 2014). To satisfy the rising consumer demand for eco-conscious and culturally meaningful products, integrating traditional craftsmanship, particularly regional needlework traditions such as Suzhou (苏绣) and Shu embroidery (蜀绣) into modern eco-friendly fashion has emerged as a viable alternative strategy. While existing scholarship predominantly examines traditional embroidery from socio-historical or purely aesthetic perspectives, fewer studies have examined how traditional embroidery-related motifs, craft practices, and cultural narratives are repositioned within contemporary sustainable fashion through different modes of adaptation. Traditional embroidery naturally aligns with the tenets of "slow fashion," utilizing localized production, natural fibers, and low-energy handcrafting techniques (Rana, 2026; Clark, 2008). However, scaling these practice artisanal skills while maintaining ecological integrity and economic viability poses significant technological and methodological challenges. This study aims to bridge this research

gap by evaluating the intersection of Chinese embroidery, sustainable materials, and emerging design technologies, such as digital archiving and AI-assisted pattern generation (Yang et al., 2025). By employing a qualitative, multi-case research design, this paper examines how artisanal "practice" is translated into codifiable "knowledge" to achieve dual cultural and ecological sustainability in modern apparel.

Literature review

Against the backdrop of the research background and research objectives clarified in the introduction chapter, this chapter systematically sorts out domestic and foreign academic literature related to traditional Chinese embroidery, sustainable fashion and cultural inheritance, to lay a solid theoretical foundation for subsequent empirical analysis and case discussion. Existing scholars have carried out multi-dimensional explorations on the combination of traditional handicrafts and eco-friendly fashion from the perspectives of cultural inheritance, environmental governance, industrial technology and consumer market, and formed rich research conclusions. In order to sort out the current research progress, identify existing research gaps, and clarify the theoretical logic of integrating Chinese embroidery into sustainable fashion, this literature review is divided into four core research dimensions for combing and commentary: cultural inheritance value of sustainable fashion, environmental optimization brought by traditional craftsmanship combined with modern technology, market demand and socio-economic value of embroidery sustainable products, and a brief summary of the overall research status.

Cultural preservation and aesthetic sustainability in modern fashion

The preservation of intangible cultural heritage (ICH) through fashion design requires moving beyond static museum conservation toward dynamic, living heritage integration (Su, 2021). Sustainable fashion frameworks have traditionally prioritized environmental, economic, and social pillars. However, recent scholarly discourses argue that cultural sustainability and aesthetic sustainability must be recognized as vital fourth and fifth dimensions (Dessein et al., 2015). As Walker (2006) asserts in his sustainable design theory, objects embedded with deep cultural narratives foster emotional durability, extending product lifespans by discouraging throwaway consumer culture. Integrating traditional Chinese embroidery motifs and stitch techniques into modern garments embeds socio-cultural memory into fashion objects, thereby transforming mass-produced apparel into culturally resilient artifacts (Scaturro, 2008) (*Figure 1*).

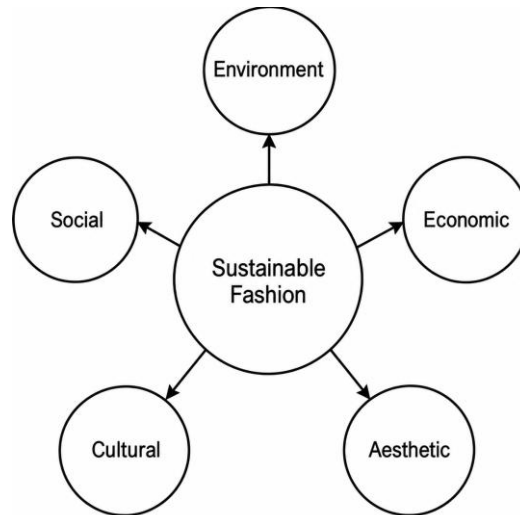


Figure 1. Sustainable Fashion five dimensions.

Ecological rationality of traditional crafts and technological integration

Traditional craft practices inherently possess an "ecological rationality", a tacit understanding of localized materials, zero-waste cutting traditions, and biodegradable inputs like silk and plant-based dyes (Fletcher, 2014). Unlike industrial textile manufacturing, hand embroidery generates minimal direct carbon emissions during production. Nevertheless, traditional embroidery faces severe bottlenecks regarding labor intensity, production cost, and market scalability. To resolve the paradox between labor-intensive craft and scalable sustainable fashion, contemporary researchers emphasize technological mediation (Holroyd, 2017). The incorporation of Computer-aided Design (CAD) and digital pattern optimization does not diminish craft authenticity; rather, it codifies tacit artisan knowledge into parameters that optimize material usage and reduce preliminary prototyping waste (Rissanen and McQuillan, 2016). Modern technological tools act as an interpretive bridge, enabling traditional embroidery to enter mainstream sustainable fashion supply chains without compromising its heritage value.

Consumer consciousness and socio-economic value

The growth of the global "conscious consumer" segment has reshaped market demand for heritage-inspired sustainable products (Joy et al., 2012). Modern luxury and eco-fashion consumers increasingly seek transparency, authenticity, and narrative value in apparel. Supporting traditional embroidery networks creates localized socio-economic value, empowering rural craft communities and preserving gendered artisanal skills (Luckman and Thomas, 2023). By fostering a collaborative ecosystem between heritage embroidery artisans and sustainable fashion designers, the industry can achieve a circular economy model that balances cultural preservation with ethical economic development. The integration of traditional Chinese embroidery into sustainable fashion represents a promising avenue for reducing the environmental impact of the fashion industry while preserving cultural heritage. By addressing the challenges of labour intensity, market acceptance and the balance between tradition and innovation, the fashion industry can leverage traditional crafts for sustainable development. Future research should focus on developing scalable methods of traditional embroidery and

exploring consumer perceptions of sustainable fashion that incorporates traditional crafts.

Materials and Methods

This study adopts a qualitative multiple-case study design to examine how traditional embroidery-related motifs, craft practices, and cultural narratives are incorporated into contemporary sustainable fashion. Qualitative inquiry is appropriate for analysing design practices embedded within cultural, technological, and commercial contexts, where meaning, material practice, and visual presentation cannot be adequately examined through numerical measurement alone (Creswell and Creswell, 2017). A multiple-case approach allows comparison across different forms of craft adaptation while retaining the specific conditions of each case (Yin, 2009). As illustrated in *Figure 2*, the research design is structured around three evidence sources: literature and theory, multiple-case documentation, and secondary institutional data. Literature and theory provide the conceptual basis for sustainable fashion, cultural heritage, design theory, and embroidery studies. Multiple-case documentation includes publicly available brand materials, runway images, collection descriptions, interviews, press coverage, and visual records related to the selected cases. Secondary institutional data provide broader cultural, environmental, and industry context through sources such as UNESCO, the Global Fashion Agenda, the Ellen MacArthur Foundation, and McKinsey & Company. The evidence was analysed through qualitative thematic analysis, which is widely used to identify and interpret patterns across qualitative materials (Braun and Clarke, 2006). The analysis focused on four themes shown in *Figure 2* where cultural sustainability, environmental sustainability, design innovation, and contemporary application. *Figure 2* therefore functions as the methodological framework of the study, showing how the data sources, analytical themes, triangulation process, and final synthesis are connected.

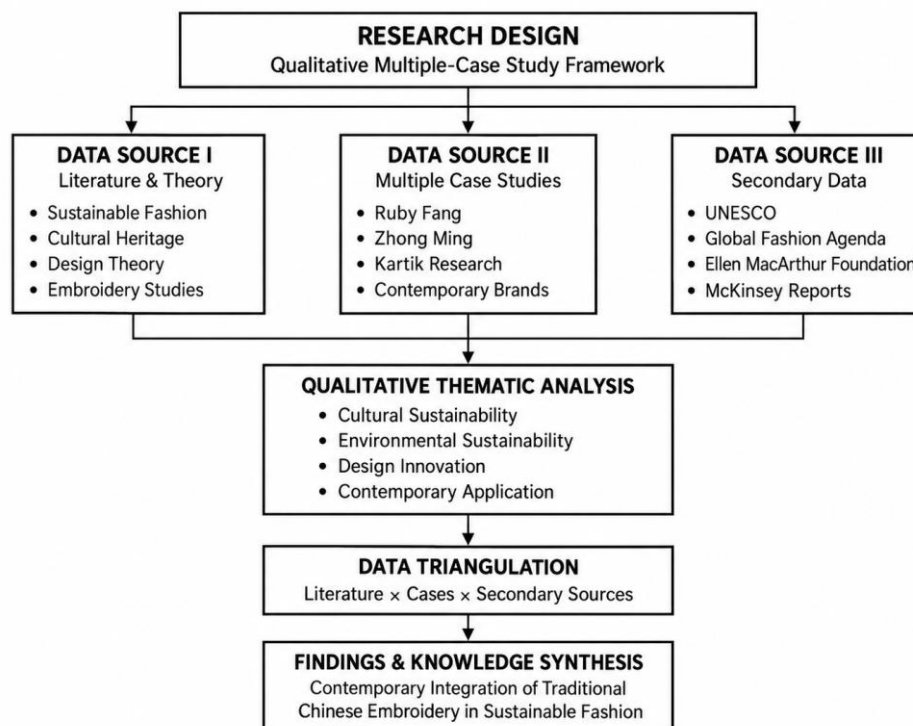


Figure 2. Research design.

Qualitative Research Design and Multiple-Case Approach

The study uses a qualitative multiple-case approach because the contemporary use of embroidery cannot be separated from design intention, motif selection, material presentation, technological mediation, cultural narrative, and market positioning. Case study research is suitable for examining a phenomenon in relation to the conditions in which it occurs (Yin, 2009). The cases were selected purposively rather than statistically. They represent three different modes of craft adaptation: motif translation in high-end sustainable couture, technological mediation in digital Shu embroidery, and based on community artisan collaboration. The purpose of comparison is not to represent the whole fashion industry, but to identify how different forms of traditional craft are positioned within contemporary sustainable fashion. As shown in *Figure 2*, the methodological framework comprises three evidence pillars. Literature and theoretical sources establish the conceptual basis of the study. Case-specific documents and visual materials provide evidence concerning design practices and public presentation. Institutional reports and cultural records supply broader contextual benchmarks concerning sustainability, cultural heritage, and fashion-industry development. These evidence categories serve different purposes and are not treated as equivalent forms of proof.

Case selection, data sources, and analytical procedure

Three cases were selected. Ruby Fang represents high-end sustainable couture and is used to examine how traditional Chinese imagery and embroidery-related surface design are translated into contemporary fashion presentation. Zhong Ming's digital Shu embroidery represents technological mediation and is used to analyse how digital tools and AI-assisted design participate in the development and communication of intangible cultural heritage. Kartik Research represents community-based artisan collaboration and provides an international comparative case for examining how handcrafted textile practices are positioned through artisan networks, cultural storytelling, and contemporary markets. The study draws on publicly available case materials, including brand websites, collection descriptions, runway images, interviews, press reports, audiovisual records, and cultural documentation. These materials were used to examine motif selection, surface treatment, material claims, design process, artisan participation, and public presentation. Brand-authored materials were treated as self-reported sources and were compared, where possible, with independent public records and media coverage. Secondary institutional sources were used to contextualise the cases. UNESCO documentation defines intangible cultural heritage and traditional craftsmanship as living knowledge, skills, and practices transmitted through communities (UNESCO, 2003). The Fashion on Climate report provides the broader industry context of fashion-related emissions and decarbonisation challenges. The Ellen MacArthur Foundation's circular economy reports were used to contextualise circular growth, product longevity, waste reduction, and systemic redesign in relation to sustainable fashion (Ellen MacArthur Foundation, 2017). Selected State of Fashion reports were used to contextualise technological change, consumer priorities, supply-chain pressures, and sustainability-related business concerns (Balchandani et al., 2023).

The analysis proceeded in three steps. First, each case was examined individually through visual and documentary analysis. Second, the findings were organised according to the four themes in *Figure 2* on cultural sustainability, environmental sustainability, design innovation, and contemporary application. Third, the cases were compared through data triangulation across brand documentation, public sources, institutional reports, and peer-reviewed literature. This process supports contextual interpretation and cross-case comparison without treating the selected examples as statistically representative of the fashion industry.

Results and Discussion

This section presents the findings from the qualitative multiple-case analysis. Following the methodological framework in *Figure 2*, the analysis examines three modes through which embroidery-related practices enter contemporary sustainable fashion: motif translation, technological mediation, and artisan collaboration. The findings are based on visual materials, case documentation, public records, and institutional sources; therefore, they are interpreted as contextual insights rather than statistically generalisable results.

Cultural Preservation and Motif Translation in Sustainable Couture

The Ruby Fang case suggests that traditional Chinese imagery and embroidery-related surface design can contribute to cultural sustainability when they are meaningfully translated into contemporary apparel. In this case, the tiger motif functions not only as visual decoration but also as a cultural sign associated with symbolic value, identity, and narrative. This supports the argument that heritage motifs can extend the cultural and emotional value of fashion objects when they are integrated into contemporary design rather than reproduced as isolated ornaments. This interpretation is consistent with emotionally durable design, which emphasises the role of attachment, meaning, and long-term value in reducing disposable relationships with products (Chapman, 2005). In the context of sustainable fashion, the relevance of embroidery lies not only in material production but also in its capacity to create cultural attachment and visual distinction. However, the available evidence does not by itself verify environmental sustainability. Claims concerning certified fabrics, material impact, or production processes require separate documentation. As shown in *Figure 3*, the tiger embroidery is positioned as a prominent surface element within the apparel presentation. The figure supports the analysis of motif translation, visual identity, and cultural reference. It should be read as evidence of visual and symbolic adaptation rather than direct proof of environmental performance.



Figure 3. Details from the Ruby Fang Spring 2024 fashion show.

Technological mediation and the epistemological shift of craft practice

The Zhong Ming case illustrates a second mode of adaptation: the use of digital tools to support the development, documentation, and communication of traditional embroidery. Rather than positioning technology and handcraft as opposing systems, this case shows how AI-assisted design and digital image development may participate in the early stages of motif exploration and public presentation. The relevance of this case lies in the relationship between tacit craft knowledge and its partial translation into digital or visual formats. Polanyi's concept of tacit knowledge is useful here because embroidery practice depends on embodied judgement, material familiarity, stitch control, and accumulated experience that cannot be fully reduced to written rules or digital parameters (Polanyi, 1966). Digital tools may support visual experimentation and documentation, but they do not replace the artisan's embodied knowledge. As shown in *Figure 4*, the AI-aided Shu embroidery example presents a technologically mediated form of heritage communication. The figure supports the argument that digital tools can expand the visual presentation and public visibility of traditional embroidery. However, it does not establish that AI directly reduces carbon emissions, production waste, or labour costs. Such claims would require process records, production data, lifecycle assessment, or independently verified technical documentation.



Figure 4. AI-aided design Shu Embroidery.
Source: Zhongming (2026).

Market positioning, artisan collaboration, and socio-economic value

The Kartik Research case provides an international comparative example of how fashion brands may position handcrafted textile practices through artisan collaboration and cultural storytelling. Although this case is not an example of Chinese embroidery, it is useful for comparison because it demonstrates a community-oriented model of heritage-related fashion. This allows the study to compare motif-based, technology-based, and artisan-network-based approaches to craft adaptation. The case suggests that artisan collaboration can strengthen the cultural visibility and market differentiation of handcrafted fashion. However, claims concerning fair wages, community empowerment, or long-term socio-economic improvement cannot be treated as established findings unless supported by independent documentation, interviews, audits, or longitudinal data. In this study, such claims are interpreted as part of the brand's public narrative rather than verified economic outcomes. As shown in *Figure 5*, Kartik Research presents embroidery and handcrafted textile work as central to its visual identity. The figure supports the analysis of artisan-centred branding, cultural storytelling, and contemporary market positioning. It does not independently verify the social or economic effects of the collaboration.



Figure 5 Kartik Research 2023.

The cross-case analysis indicates that embroidery-related practices enter contemporary sustainable fashion through three main pathways. First, motif translation supports cultural sustainability by recontextualising traditional imagery within contemporary apparel. Second, technological mediation supports the documentation, development, and public communication of craft practice, although it cannot replace embodied artisan knowledge. Third, artisan collaboration can contribute to cultural visibility and market differentiation, but its socio-economic effects require stronger independent evidence. Across the three cases, cultural sustainability is the most clearly supported dimension because it can be examined through visual analysis, motif interpretation, and documentary evidence. Environmental sustainability is more difficult to verify because the study does not include lifecycle assessment, material certification records, or production measurements. Socio-economic sustainability is also limited by the lack of independent data on artisan income, labour conditions, or long-term community outcomes. The findings therefore suggest that traditional embroidery can contribute to sustainable fashion discourse, but its cultural, environmental, and socio-economic dimensions must be assessed separately.

The findings suggest that the contribution of traditional embroidery to sustainable fashion is not uniform across cultural, environmental, and socio-economic dimensions. Across the three cases, the strongest evidence concerns cultural sustainability. Traditional motifs, handcrafted surface treatment, and heritage-related narratives can give apparel symbolic value and emotional attachment, which are relevant to sustainable fashion because they may extend the perceived value and use-life of clothing (Chapman, 2005). This finding is also consistent with UNESCO's understanding of intangible cultural heritage as living knowledge, skills, and practices transmitted through communities rather than fixed historical objects (UNESCO, 2003). The

environmental dimension requires more cautious interpretation. Traditional embroidery may align with slow fashion values when it involves durable materials, careful production, and lower-volume making. However, the present study does not provide lifecycle assessment, verified material data, or production measurements. Therefore, it cannot claim that embroidery practices automatically reduce environmental impact. Industry reports such as Fashion on Climate and the Ellen MacArthur Foundation's textile report are useful for contextualising fashion-sector emissions, waste, circularity, and the need for systemic redesign, but they do not verify the environmental performance of the selected cases.

The technological case also shows that digital tools should be understood as mediating instruments rather than replacements for craft knowledge. AI-assisted design may support visual experimentation, documentation, and public communication, but embroidery remains dependent on tacit knowledge, material judgement, and hand-based skill. This supports Polanyi's argument that practical knowledge cannot be fully converted into explicit rules or technical systems (Polanyi, 1966). The value of technology in this context lies in extending the visibility and adaptability of craft practice, not in proving sustainability by itself. The comparison with Kartik Research indicates that artisan collaboration can strengthen the cultural and market positioning of heritage-informed fashion. However, claims about fair wages, community empowerment, or long-term socio-economic improvement require independent evidence. In this study, such claims are treated as part of the brand's public narrative unless supported by external documentation. The broader implication is that sustainable fashion research must distinguish between cultural visibility, environmental performance, and socio-economic impact. These dimensions may overlap, but they cannot be assumed to prove one another. Overall, the study contributes a cautious framework for understanding how traditional embroidery may participate in sustainable fashion. Its main contribution is not to prove that embroidery is inherently sustainable, but to clarify the conditions under which embroidery-related design can support cultural continuity, design innovation, and more reflective forms of fashion consumption.

Conclusion

This study examined how traditional embroidery-related motifs, craft practices, and cultural narratives are incorporated into contemporary sustainable fashion through a qualitative multiple-case analysis. The findings indicate that traditional embroidery contributes most clearly to cultural sustainability through motif translation, heritage-based storytelling, and the creation of symbolic and emotional value in apparel. These dimensions show how embroidery can move beyond surface decoration and function as a culturally meaningful design practice. The study also shows that digital tools and artisan collaboration can support the contemporary adaptation of traditional craft. AI-assisted design may expand visual experimentation and public communication, while artisan-centred collaboration may strengthen the cultural and market visibility of handcrafted textiles. However, these forms of adaptation should not be treated as automatic evidence of environmental or socio-economic sustainability. Environmental claims require verified material data, production records, lifecycle assessment, or other forms of independent evidence. Socio-economic claims require stronger documentation of artisan participation, labour conditions, income effects, and long-term community outcomes. The main contribution of this study is to clarify the conditions under which

traditional embroidery may participate in sustainable fashion discourse. It argues that embroidery becomes relevant to sustainable fashion when it is treated as a culturally embedded, materially situated, and socially connected design practice, rather than as decoration alone. Future research should examine verified production data, consumer reception, and artisan perspectives to assess more precisely the environmental and socio-economic outcomes of integrating traditional craft into contemporary apparel.

Acknowledgement

This research is self-funded.

Conflict of interest

The authors confirm that there is no conflict of interest involve with any parties in this research study.

REFERENCES

- [1] Balchandani, A., Starzynska, E., Berg, A., D'Auria, G., Rölkens, F., Amed, I. (2023): The state of fashion 2024: Finding pockets of growth as uncertainty reigns. – McKinsey & Company and The Business of Fashion, United Kingdom 128p.
- [2] Braun, V., Clarke, V. (2006): Using thematic analysis in psychology. – *Qualitative Research in Psychology* 3(2): 77-101.
- [3] Chapman, J. (2005): *Emotionally durable design: Objects, experiences and empathy*. – Routledge, London 211p.
- [4] Clark, H. (2008): Slow + fashion—an oxymoron—or a promise for the future ...? – *Fashion Theory* 12(4): 427-446.
- [5] Creswell, J.W., Creswell, J.D. (2017): *Research design: Qualitative, quantitative, and mixed methods approaches*. – SAGE Publications, Thousand Oaks 304p.
- [6] Dessein, J., Soini, K., Fairclough, G., Horlings, L. (eds.) (2015): *Culture in, for and as sustainable development: Conclusions from the COST Action IS1007 investigating cultural sustainability*. – University of Jyväskylä, Jyväskylä 73p.
- [7] Ellen MacArthur Foundation (2017): *A new textiles economy: Redesigning fashion's future*. – Ellen MacArthur Foundation, United Kingdom 150p.
- [8] Fletcher, K. (2014): *Sustainable fashion and textiles: Design journeys*. – Routledge, London 288p.
- [9] Holroyd, A.T. (2017): *Folk fashion: Understanding homemade clothes*. – I.B. Tauris, London 256p.
- [10] Joy, A., Sherry Jr, J.F., Venkatesh, A., Wang, J., Chan, R. (2012): Fast fashion, sustainability, and the ethical appeal of luxury brands. – *Fashion Theory* 16(3): 273-295.
- [11] Luckman, S., Thomas, N. (eds.) (2023): *Craft communities*. – Bloomsbury Publishing, London 232p.
- [12] Niinimäki, K., Peters, G., Dahlbo, H., Perry, P., Rissanen, T., Gwilt, A. (2020): The environmental price of fast fashion. – *Nature Reviews Earth & Environment* 1(4): 189-200.
- [13] Polanyi, M. (1966): The logic of tacit inference. – *Philosophy* 41(155): 1-18.
- [14] Rana, N.R. (2026): Designing with communities: A framework for undergraduate research in sustainable fashion. – *Base Diseño e Innovación* 10(12): 100-115.
- [15] Rissanen, T., McQuillan, H. (2016): *Zero waste fashion design*. – Bloomsbury Academic, London 224p.

- [16] Scaturro, S. (2008): Eco-tech fashion: Rationalizing technology in sustainable fashion. – *Fashion Theory* 12(4): 469-488.
- [17] Su, J. (2021): A difficult integration of authenticity and intangible cultural heritage? The case of Yunnan, China. – *China Perspectives* 2021(3): 29-39.
- [18] UNESCO (2003): Convention for the safeguarding of the intangible cultural heritage. – United Nations Educational, Scientific and Cultural Organization, Paris 20p.
- [19] Walker, S. (2006): *Sustainable by design: Explorations in theory and practice*. – Routledge, London 256p.
- [20] Yang, H., Sui, Q., Hu, B., Shi, K., Wang, R., Li, M. (2025): A semantic reconstruction and AI-controlled generation method for the cultural genes of Qing Dynasty embroidery patterns: A case study of official rank badges. – *npj Heritage Science* 13: 18p.
- [21] Yin, R.K. (2009): *Case study research: Design and methods*. – SAGE Publications, Thousand Oaks 219p.