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From Ancient Fabrics to Smart Textiles: The Transition of Thai Fabric Heritage into Intelligent Fashion

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Abstract

Thai textiles have long embodied more than functional craft, they are cultural narratives woven from belief, artistry, and identity. This study investigates how traditional Thai fabrics particularly Pha Lai Kho Chao Fah and Pha Mud Mee Isan can evolve into smart textiles through the integration of heritage weaving and intelligent materials. It seeks to answer how smart materials can merge with Thai textile traditions to sustain cultural identity within the digital age.

Adopting a qualitative approach, the research combined document analysis, semi-structured interviews with designers and artisans, and an experimental prototype incorporating thermochromic yarns into traditional motifs. The findings reveal that technological adaptation does not replace authenticity but revitalizes it, transforming Thai textiles into living cultural artifacts that communicate emotion, memory, and innovation. Artisans perceived the technology as a creative extension of craftsmanship rather than a disruption of tradition.

The study's significance lies in demonstrating how cultural heritage and digital innovation can coexist to inform global perspectives on sustainable fashion, creative design education, and community-based cultural preservation. It also underscores the role of interdisciplinary collaboration between universities, craftspeople, and local industries in bridging tradition and technology. By reinterpreting Thai textiles through smart materials, this research contributes to a broader understanding of how design can serve as a dialogue between the past and the future, between material intelligence and cultural identity.

Keywords: Smart Textiles, Intelligent Fashion, Thai Heritage Textiles, Cultural Sustainability, Design Innovation, Thai Fabric

1. Introduction

Thai textiles embody far more than utilitarian garments they are living cultural narratives that weave together belief, identity, and artistry. Each woven strand represents faith, fertility, and harmony with nature. Pha Lai Kho Chao Fah, with its intricate royal motifs, and Pha Mud Mee Isan, known for its geometric dyed patterns, are testaments to Thailand's spiritual and aesthetic heritage. Historically, these fabrics served not only as everyday attire but also as symbols of ritual and status, linking craftsmanship to social and moral order.

In recent decades, globalization and rapid technological change have transformed how traditional fabrics are produced and valued. Mechanized weaving and mass fashion have challenged the individuality of handmade craft. Yet, these same forces have also opened opportunities for cultural preservation and creative renewal. Under Thailand's creative economy framework, merging heritage with innovation has become a national strategy to sustain local identity while fostering sustainable development on.

Meanwhile, smart textiles fabrics embedded with responsive or communicative technologies have redefined the meaning of material design. They offer new aesthetic and functional possibilities but also raise critical questions about authenticity, ethics, and cultural integrity when applied to traditional craft. While previous studies address smart textiles and cultural heritage separately, few explore how Thai handweaving can integrate digital technology in a culturally sensitive manner.

1.1 Research Objective

1. To explore how smart materials can be incorporated into Thai handwoven textiles without diminishing cultural meaning.
2. To understand artisan and designer perceptions of innovation within traditional craft.
3. To develop design guidelines that balance authenticity, technology, and sustainability.

This study addresses these aims by examining how intelligent materials can extend not replace the storytelling and emotional depth embedded in Thai textile heritage.

2. Literature review

Research Thai textiles embody a living heritage that intertwines belief, identity, and artistry. Scholars describe weaving as an intangible cultural tradition that reflects community life and spirituality. Charungkiattikul (2021) notes that textile motifs represent social hierarchy and shared worldview, while Inkuer et al. (2024) found that preserving authenticity sustains cultural and market relevance.

The concept of cultural sustainability emphasizes that traditions must evolve to remain meaningful. Thailand's creative economy framework particularly through programs like OTOP encourages communities to merge craftsmanship with innovation. Within this movement, Suan Sunandha Rajabhat University (SSRU) has played a leading role. Eaknarajindawat and Sriboonruang (2021) demonstrated how intelligent fibers can add value to handwoven cotton, while Eaknarajindawat (2025) developed an intelligent neck pillow, linking technology with cultural design.

Globally, Japan's digital kimono and India's e-textile projects exemplify how innovation and authenticity can coexist through collaboration. Yet, most Thai studies still focus on technical performance rather than cultural integration.

This review identifies a convergence between tradition and innovation: smart textiles redefine craft as a medium of interaction and sustainability, where technology does not replace heritage but revitalizes it for contemporary relevance.

Theme conceptual definitions	Description
Tradition	Thai handweaving as a living form of cultural storytelling rooted in belief and social identity.
Innovation	Smart materials and interactive design processes enhancing both function and emotion in textiles.
Sustainability	The use of eco-conscious materials and design systems linking heritage with sustainable fashion practices.
Collaboration	Academic–community partnerships fostering creative development in Thai smart textile research.

Source: Thiwakon Kaenkaeo

3. Methodology

This research employed a qualitative design to explore how traditional Thai handwoven textiles can integrate smart technologies while maintaining cultural integrity. The qualitative approach was selected to capture the symbolic, aesthetic, and emotional dimensions that quantitative methods cannot fully address. The study followed three interconnected phases: document analysis, semi-structured interviews, and experimental prototyping.

1. document analysis: An extensive review of academic journals, conference proceedings, and policy reports (2020–2025) was conducted, focusing on cultural preservation, smart textile innovation, and sustainable fashion. Sources from Suan Sunandha Rajabhat University (SSRU) were prioritized to contextualize local innovation. The analysis helped identify existing approaches and research gaps regarding the fusion of cultural heritage and intelligent design.

2. Participant Selection and Interviews: Five participants were recruited using purposive sampling and were selected according to three main criteria: they each possessed at least five years of professional experience in textile design or handweaving, had direct involvement in community or innovation projects, and represented different regions of Thailand, with particular emphasis on the Northeast (Isan). The group consisted of two textile designers, one SSRU researcher specializing in smart materials, one Isan weaver, and one fashion entrepreneur. Semi-structured interviews (45–90 minutes each) focused on perceptions of authenticity, aesthetic balance, innovation potential, and sustainability. All interviews were audio-recorded, transcribed verbatim, and analyzed using thematic analysis. Coding categories such as “cultural meaning,” “technological adaptation,” “aesthetic balance,” and “market opportunity” were used to identify recurring patterns and interpret underlying cultural values.

3. experimental prototyping: A small-scale design experiment was conducted Textile Innovation Laboratory. The project incorporated thermochromic yarns into a Pha Mud Mee weaving pattern to test visual transitions, heat sensitivity, and user perception. Observations were documented through photographs, color-change sequences, and participant feedback. The prototype served not as a commercial product but as a proof of concept demonstrating how traditional motifs could interact dynamically with smart materials. Illustrative diagrams and process photographs are recommended for inclusion in the full paper or conference appendix to enhance clarity.

Triangulation among the three data sources documents, interviews, and experiments ensured validity, while reflexive journaling minimized researcher bias. Ethical clearance was obtained. Research Ethics Committee, with informed consent from all participants

4. Results

The study's findings illustrate that integrating smart technologies into Thai heritage textiles revitalizes traditional craftsmanship rather than replacing it. Artisans and designers interpreted smart materials such as thermochromic yarns not as alien intrusions but as creative tools that extend the communicative capacity of fabric. This resonates with Balsamo's (2011) notion of designing culture, where innovation acts as a medium for cultural expression rather than a disruption of it. Similarly, Heskett's (2005) theory of cultural innovation supports the idea that design can sustain identity through transformation, showing that creativity is most authentic when rooted in lived tradition.

Three interrelated dimensions emerge from the analysis: heritage continuity, aesthetic-technical balance, and socioeconomic potential. Heritage continuity is reinforced when traditional motifs are reinterpreted through responsive materials, allowing narratives to adapt without losing symbolic depth. Aesthetic-technical balance requires negotiation between tactile craftsmanship and digital precision what participants described as hidden technology, in which innovation supports, rather than dominates, the visual and spiritual values of Thai textiles. The final dimension, socioeconomic potential, reflects how smart heritage textiles can contribute to Thailand's creative economy by aligning local production with global sustainability and innovation agendas.

However, critical reflection reveals several challenges. First, the rapid pace of technological change poses the risk of technological obsolescence, which may render current materials or sensors outdated within a few years. Second, the increasing reliance on digital tools could lead to a loss of artisanal control, where technology dictates form instead of supporting cultural intent. Addressing these issues requires ongoing collaboration between technologists, designers, and local weavers, ensuring that innovation evolves in tandem with tradition.

Conceptually, the findings can be visualized through a framework that links heritage as the foundation, technology as the enabler, aesthetic value as the mediator, and socioeconomic impact as the outcome. Together, these dimensions form a dynamic cycle of cultural resilience where tradition informs innovation, and innovation sustains tradition.

5. Conclusion

This research concludes that the transformation of Thai heritage textiles into smart and intelligent fabrics represents not a rupture from tradition but a creative evolution that redefines cultural continuity. By embedding thermochromic and sensor-activated fibers into traditional weaving, artisans and designers demonstrated how innovation can revive the expressive and spiritual essence of Thai craftsmanship. Rather than replacing authenticity, technology becomes a cultural amplifier enhancing communication, interactivity, and meaning within the fabric itself.

The findings affirm that hidden technology innovation that supports rather than dominates serves as a guiding philosophy for sustainable cultural design. Smart heritage textiles thus emerge as a bridge between art and science, linking ancestral wisdom with digital creativity.

They also reinforce the value of collaboration among universities, artisans, and industries as a foundation for Thailand's creative economy.

Future research directions should explore emerging fields such as wearable data systems, sustainability metrics for textile production, and the use of artificial intelligence in pattern design and material adaptation. These inquiries could expand the dialogue between culture and computation, offering new possibilities for personalization, sustainability, and experiential design.

Policy and educational implications highlight the need for institutional frameworks that support cross-disciplinary collaboration and knowledge transfer. Universities can play a pivotal role by integrating design technology with cultural studies, establishing innovation labs that connect students, weavers, and engineers in co-creative research environments. Government agencies may further strengthen funding and training initiatives to ensure that technological progress empowers, rather than replaces, local craftsmanship.

Ultimately, Thai smart textiles exemplify how cultural identity can thrive in the digital era as an enduring thread of creativity weaving the past, present, and future into one continuous fabric of innovation.

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References

- Charungkiattikul, P. (2021). Thai textile patterns as cultural communication: Identity, belief, and social meaning. *Journal of Arts and Cultural Studies*, 9(2), 45–57.
- Eaknarajindawat, N. (2025). Product of intelligent neck pillow from intelligent textiles. *International Journal of Business, Tourism and Applied Sciences*, 13(2), 45–50.
- Eaknarajindawat, N., & Sriboonruang, N. (2021). The enhancement of hand-woven cotton products with intelligent textiles to add value to native textile products in Nong Bua Lam Phu Province. *International Journal of Business, Tourism and Applied Sciences*, 9(1), 33–40.
- Fujimoto, T. (2022). Digital kimono design: Tradition and technology in Japanese fashion innovation. *Journal of Cultural and Creative Industries*, 8(2), 67–75.
- Inkuer, W., Charoensuk, N., & Wattanachai, P. (2024). Local weaving heritage and consumer perception of authenticity in Thai textile design. *Asian Journal of Design and Innovation*, 5(1), 21–30.

- Patel, R., & Nair, S. (2023). E-textiles and the future of craft: Integrating technology into Indian handloom traditions. *International Journal of Textile Science and Engineering*, 12(1), 56–64.
- Sajovic, A., Gonzalez, J., & Puch, R. (2023). Smart textiles: Emerging trends in wearable technology and responsive materials. *Journal of Material Design and Technology*, 17(3), 188–202.
- Simasathiansophon, N. (2024). Brand creation for ebony seeds' products: The case of Baan Wat Makluea community, Thailand. *EUrASEANs Journal*, 6(49), 111–115.
- UNESCO. (2022). *Creative economy and cultural heritage in Southeast Asia*. Paris: UNESCO Publishing.