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Integrating Traditional Saudi Textile Arts into Eco-Conscious Product Design for Sustainable Product Innovation: A Mixed-Methods Study in the Kingdom of Saudi Arabia

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Abstract

This study aimed to propose a framework integrating traditional Saudi textile arts into eco-conscious product design for sustainable product innovation. A convergent parallel mixed-methods design was adopted, combining a workshop with observation, semi-structured interviews, and a survey conducted in four regions of Saudi Arabia (Riyadh/Najd, Asir, Makkah/Hejaz, and Eastern Province) across three consecutive phases between September 2024 and February 2025. A total of 416 usable survey responses were obtained alongside 26 interviews and six co-design workshops involving master artisans, emerging artisans, designers, and consumers of craft products. Quantitative analysis (descriptive statistics, t-tests, ANOVA, principal components analysis) and reflexive thematic analysis of qualitative data were triangulated through a joint-display matrix. Four latent design principles emerged from the data — Cultural Faithfulness, Material Locality, Economic Viability, and Circularity & Renewal — together explaining 67.3% of variance in stakeholder attitudes. Three integrative qualitative themes (Motif as Covenant, the Forgotten Greenness of the Old Ways, and Co-Design as Intergenerational Workshop) enriched these findings. Although many sustainable design frameworks have been proposed in the literature, none addresses artisan sovereignty as a core organising principle. The main contribution of this study is the Saudi Eco-Craft Design Framework (S-ECDF), which positions the four operational design principles around a core commitment to artisan sovereignty over cultural knowledge. The framework offers an empirically grounded, culturally faithful pathway for the integration of Saudi craft heritage into Vision 2030's creative industries and circular-economy agenda.

Keywords: *Sadu Weaving, Al-Qatt Al-Asiri, Sustainable Design, Circular Econom, Saudi Vision 2030, Saudi Craft Heritage, Eco-Conscious Product Desig, Artisan Sovereignty.*

Introduction

1.1. Background to the study topic

Integrating traditional Saudi textile arts, such as Al-Sadu, into modern product design can drive sustainable innovation through zero-waste, eco-friendly practices and cultural preservation. Saudi designers and artisans are blending heritage with modern technology, using recycled materials and sustainable dyes to create eco-conscious, high-quality products. Key initiatives include upcycling, digital manufacturing, and merging traditional motifs with contemporary, durable design. While observing these trends, [1] listed the challenges of competition from industrial textiles and the need for sustainable practices. Tourism and global markets provide opportunities for the growth of Saudi traditional textiles. This will sustain community traditions and provide livelihood opportunities for artisans. A study by [2] showed that a zero-waste fashion design, especially in Al-Sadu fabric, achieves sustainability and the ethical use of traditional

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crafts. Sustainable materials with 3D technology are used in the case of Chaldene fabrics. A 25% increase in the use of sustainable materials has been achieved in the Saudi handicraft industry's textile sector [1]. Collaboration between Turquoise Mountain and local artisans focuses on reviving traditional crafts with modern, sustainable techniques. Ethical production is adopted with investment in a circular fashion, including ethical sourcing and textile-to-textile recycling. Sustainable innovation leads to cultural identity by framing sustainability as a tool to preserve cultural heritage. This offers a unique selling opportunity in local and global markets. Upcycling discarded materials (like Hajj ihrams) into new, functional products creates a circular economy, leading to local economic growth [3].

1.2. Saudi Vision 2030 and Quality of Life Programme

The Quality of Life Program (QoL), launched in 2018, is a core Vision Realisation Program (VRP) of Saudi Vision 2030. Its primary mission is to transform Saudi Arabia into a top global destination by enhancing both liveability (urban infrastructure and services) and lifestyle (recreation and culture) [4]. The strategic objectives of the programme are to increase public participation in sports and athletics, achieve regional and global excellence in selected sports, promote Saudi Arabia's contribution to arts and culture, develop and diversify entertainment opportunities to meet people's needs, conserve and promote Islamic, Arabic and national heritage, improve urban landscape in cities, improve quality of services in cities, improve living conditions of expats, develop tourism sector, enhance national immunity to drug abuse. The targets for 2030 were three cities of Saudi Arabia in the top 100 liveable cities in the world, over 1,43,000 employees in the cultural sector, over 600 new entertainment attractions, and over 6.700 days of cultural events. According to [5], Saudi Arabia has progressed considerably in its Quality of Life Programme. It is a leading contributor to the UN-Habitat Quality of Life Initiative. There are significant improvements in urban liveability, inclusion, and well-being that have translated into measurable economic outcomes, preparing Saudi Arabia well for its future-ready cities that offer higher standards of living for all. Unemployment decreased, women's participation and investment licenses increased, and life expectancy increased significantly.

1.3. Heritage Commission initiatives

The Heritage Commission is a specialised Saudi Arabian government agency established in February 2020 under the Ministry of Culture. Its primary mission is to document, preserve, and promote the Kingdom's diverse cultural heritage, ranging from ancient archaeological sites to traditional handicrafts. It manages a multi-billion dollar portfolio of initiatives aimed at documenting, restoring, and promoting the Kingdom's cultural assets. Its strategy is built on eight pillars, including the effective management of cultural wealth and the use of digital technologies in heritage preservation. Key initiatives include modern urban heritage initiatives [6], Aadat national campaigns, Little Explorer initiatives, Saudi Noqush (inscriptions), and underwater cultural initiatives. The strategic milestones are the registration of 10061 archaeological sites as of June 2025, a partnership with UNESCO to preserve documentary heritage and manage World Heritage Sites, and the setting up of business accelerators to empower entrepreneurs in the heritage sector. Major restoration projects include Diriya Gate, the restoration of Saudi Arabia's birthplace, the urban regeneration of UNESCO-listed historic district at Al-Balad, in the old Jeddah region and the restoration of many historical mosques under the Prince Mohammed bin Salman Project. According to [7], such heritage preservation efforts promote sustainability.

1.4. The environmental burden of fast-fashion imports

In Saudi Arabia, the environmental burden of fast-fashion imports is characterised by a "throwaway culture" that contributes to a massive global waste crisis, where the fashion industry is responsible for 10% of global greenhouse gas emissions. While Saudi Arabia is actively weaving sustainability into its local fashion sector to combat this, the reliance on rapid imports poses significant long-term ecological risks [8]. Key environmental burden factors are textile waste accumulation, water scarcity and pollution, microplastic pollution, and high carbon footprint. To address the issue of waste, Saudi Arabia is investing in circularity. This model focuses on reusing, recycling, and upcycling clothing to extend its life cycle and thereby reduces environmental risks. These initiatives reflect the positive environmental attitude of Saudi consumers, influencing their fashion purchase intentions [9].

1.5. The research gap on integrating traditional textile crafts (Sadu, Al-Qatt Al-Asiri, Al-Mismak embroidery, Bisht weaving) into contemporary eco-design

Research into integrating traditional Saudi textile crafts—Sadu (weaving), Al-Qatt Al-Asiri (wall art adapted to textiles), Al-Mismak embroidery, and Bisht weaving—into contemporary eco-design shows promising developments, particularly within zero-waste fashion and cultural heritage preservation. However, significant research gaps remain regarding the technical, supply chain, and scalability aspects of these integrations. Technical and material innovation gaps exist in the standardisation of eco-friendly dyes, performance of traditional materials in modern contexts, and eco-friendly adhesives and stabilisers. Practical frameworks are not available to link traditional Bedouin artisans with eco-conscious designers directly. If directly connected, it will deny fair compensation to artisans and affect the authenticity of the craft. Commercial feasibility of upcycling pre-consumer waste is yet to be proven. There is a gap in developing methodologies that are specific, documented, and practice-led to integrate traditional, slow-production techniques (Sadu weaving) with fast, modern, eco-friendly manufacturing technologies like 3D printing or CAD. Although visual research exists on Al-Qatt Al-Asiri, the technical application of the complex and symbolic patterns on sustainable fabric surfaces, without the loss of their structural integrity, is unknown. There is only limited research on the willingness of modern Saudi consumers to pay a premium price for eco-designed, authentic, hand-made Sadu or Al-Mismak embroidery. A full life-cycle assessment comparing the environmental footprint of traditional, locally made Sadu products with a locally produced modern sustainable equivalent is still to be done. There are also some additional areas for research. These include digital documentation for sustainability, and adaptation of the Sustainable Textile Repair through Indigenous Embroidery (STRIPE) from the Indian Toda embroidery to repair industrial textile wastes of Sadu or Al-Mismak patterns to upcycle factory waste.

The above background and the gaps lead to the following aim, objectives and research questions:

Aim: To integrate traditional Saudi textile arts into eco-conscious product design for sustainable product innovation.

Research objectives:

- To examine how artisans, designers, and consumers compare regarding perceptions on eco-conscious integration.

- To explore the current sustainability practices of artisans.
- To identify the latent principles emerging from stakeholder attitudes.
- To identify themes related to eco-conscious integration from qualitative data.
- To design an integrated framework for the operational design principles around a core commitment to artisan sovereignty over cultural knowledge.

Research questions:

The research questions corresponding to the objectives are-

- How do artisans, designers, and consumers compare regarding perceptions on eco-conscious integration?
- What are the current sustainability practices of artisans?
- What are the latent principles emerging from stakeholder attitudes?
- What are the themes emerging from the qualitative data on eco-conscious integration?
- What is the scope of designing an integrated framework for the operational design principles around a core commitment to artisan sovereignty over cultural knowledge?

2. Literature Review

2.1. Traditional Saudi textile arts and their regional variations

Traditional Saudi textile arts, including Al Sadu weaving, intricate embroidery, and palm frond weaving, reflect a rich Bedouin heritage using natural wool, camel hair, and goat hair. Regional variations are significant: the central Najd region features muted colours and geometric patterns, while southern areas like Jazan use vibrant colours and Jasmine garlands. Common garments include the *thobe* (tunic), *sidairi* (vest), and the black abaya [10].

Traditional Saudi textile arts are a vibrant reflection of the Kingdom's diverse geography, history, and cultural identities. Across regions such as Najd, Hijaz, Asir, Hail, Taif, and Jazan, distinctive weaving, embroidery, beadwork, and decorative motifs have evolved—each shaped by local customs, environmental factors, and social structures [11]; [12]; [13]; [14]; [15]; [16]; [17]; [18]. These textile traditions serve not only as functional clothing or household items but also as markers of regional identity and heritage. For example, the Najd region is renowned for its intricate embroidery on women's garments [11], while the Asir region is celebrated for its geometric "Al-Qatt Al-Asiri" motifs [19]; [20]; [21]. The Hijaz region features embroidered bridal costumes with unique colour palettes and embellishments [17] [22]. Modernisation and urbanisation have posed challenges to the preservation of these crafts; however, there is a growing movement to revive and adapt traditional techniques for contemporary fashion and design [13]; [23]; [17].

Regional distinctions exist in Saudi textile arts. Najd is known for simple yet elegant embroidery on women's garments using harmonious colours and varied stitches; Bedouin weaving (Sadu) is prominent [11]; Mansour & Al-Sahhari, 2024). Hijaz features elaborate bridal costumes with heavy embroidery—especially around necklines and sleeves—using red as a dominant colour along with yellow, blue, and green; beadwork is also common [17]; [22]; [24] Nazer & Mohammed, 2018). Asir is distinguished by geometric "Al-Qatt Al-Asiri" wall art motifs adapted into textiles; bright natural colours are characteristic [19]; [20]; [21]. In the case of Hail and Taif regions, traditional clothing incorporates local motifs; beadwork ornamentation is notable in Taif

[12]; [24].

There are also differences in techniques and motifs. Sadu weaving by Bedouin women uses warp-faced techniques to create strong fabrics for tents/dividers; patterns often indicate tribal or personal identity [25]; [26]. Regional styles of embroidery differ in stitch types, placement (neckline/sleeves/hems), colour schemes, and use of metallic threads or beads [11,17]. Beadwork is widely used in Taif province. It is used to embellish dresses with geometric or floral patterns [24].

Cultural identity and its significance are influenced by textile arts, which serve as historical records of social status, marital status, tribal affiliation, and local customs. Women's traditional dress often signals regional origin through specific decorative elements [11,17]. The integration of motifs from architecture (e.g., Najdi doors) further reinforces cultural identity [14]; [27].

Contemporary designers are reviving traditional techniques by integrating them into modern apparel/accessories—balancing authenticity with innovation [13,22,23]. In adapting modern technology, the sustainability of textile arts is protected using different approaches. Sustainability efforts include recycling fabrics using patchwork methods inspired by Asiri art [19], digital design adaptations for youth engagement [14], and supporting small artisan projects in regions like Jazan [28].

With moderate to strong evidence, the above-reviewed papers demonstrate that traditional Saudi textile arts are deeply intertwined with regional identities—each area developing unique motifs and techniques influenced by environment and culture [11,12]. While modernisation has threatened some practices (e.g., decline of nomadic weaving), there is robust scholarly interest in documenting these traditions before they disappear entirely [29]. Recent research highlights successful efforts to adapt heritage crafts for contemporary use—such as digital designs inspired by architectural motifs or sustainable fashion initiatives using recycled materials from Asir art traditions (Al-Mutairi et al., 2021; [19].

2.2. Sustainable and circular product design frameworks (Cradle to Cradle, biomimicry, slow design)

Sustainable and circular product design frameworks are central to the transition from linear "take-make-dispose" models to regenerative, resource-efficient systems. Key frameworks such as Cradle to Cradle (C2C), biomimicry, and slow design have shaped the discourse by emphasising closed material loops, nature-inspired innovation, and longevity in product use. Recent literature highlights the integration of these principles into practical methodologies, such as closed-loop sustainable product design, 3R-strategies (Reduce, Reuse, Recover, Rethink), and multi-loop life cycle approaches [30]; [31]; [32]; [33]. The field has evolved to include holistic perspectives—considering not only materials and processes but also business models, stakeholder engagement, digital technologies (e.g., AI), and systemic thinking [34]; [35]; [36]; [37]. Despite progress, challenges remain in standardising frameworks, addressing social dimensions, and operationalising circularity across industries [38]; [39]; [40].

The major circular design frameworks are the Slowing, Closing, and Narrowing loops, widely used to structure strategies such as long life, reuse/repair (slowing), recycling and take-back (closing), and efficiency (narrowing) [[30]; [31]; [32]; [33]], the Closed-loop sustainable product design: Integrates triple bottom line, 6Rs, life cycle thinking, and flow circularity metrics, adding "society-at-large" as a key stakeholder and emphasising perpetual resource [41], Circular

Economy Design Diagram (CEDD), which maps technological and biological cycles together and links them to four "areas of decision" across production, use, and end-of-life to generate sustainable alternatives [42], and Circular Design (CD) as an evolution of eco-design, focusing on preserving value, viewing waste as a resource, and drawing explicitly on cradle to cradle philosophy [43]; [34].

There are four core circular-strategy clusters reported in the literature. Slow designs are slowing down or extending product life for durability, repairability, emotional durability, and product–service systems [31]; [32]; [35]; [36]. Closed-loop designs are for disassembly, remanufacturing, recycling, and modularity [41]; [30]; [31]; [32]. Narrow loop designs are for resource-efficient, lean, eco-design, smart Industry 4.0 support [30]; [41]; [39]. Bio-based/bio-inspired loops are for biological cycles, safe materials, nature-like flows [31], [42]; [34]; [43].

Cradle-to-cradle (C2C) underpins many frameworks, emphasising safe materials, eliminating waste, and distinct technical vs biological cycles [31]; [42]; [34]; [38]. A Genomic Model of Eco-innovation and Eco-design (MGE2) explicitly integrates C2C, life cycle assessment, and certification to guide closed-loop product systems [38]. Biomimicry / bio-inspired design has a circular product design framework, including "design for bio-inspired loops" and "bio-based loops," imitating natural systems and using renewable, non-toxic materials [31]; [34]; [40]; [44].

Frameworks and tools support circularity across new product development stages, but are strongest in early planning and concept phases [36]; [37]; [45]. Examples include a 10-category CDFramework and a self-assessment tool (covering challenge, business model, materials, use, and afteruse) [37], 4R principles (Reduce, Reuse, Recover, Rethink) for redesign [46], and mapped portfolios of 77 circular design tools classified by NPD phase and strategy.

With moderate to strong evidence, the above papers show that circular design is framed as an evolution of eco-design, structured around slowing, closing, and narrowing resource loops, and strongly influenced by cradletocradle and nature-inspired thinking. Frameworks increasingly combine product-level "slow" strategies (durability, repair, emotional attachment) with system-level planning for closed technological and biological cycles. Tools and typologies aim to make these principles actionable in real design and development processes.

2.3. Craft-based innovation in the Gulf and wider MENA contexts

Craft-based innovation in the Gulf and MENA sits at the crossroads of heritage preservation, local development, and creative industries. Research highlights how traditional crafts are being reimagined through design, entrepreneurship, clustering, and policy to stay relevant in contemporary markets.

2.3.1. Conceptual Foundations: Craft, Culture, and Innovation

Craft is framed as "advanced craft": high expertise plus innovation, scaling, and technology, while preserving materiality, authenticity, and tradition [47]. Innovation in traditional handicrafts is seen as essential for competitiveness and sustainable development, with a strong emphasis on incremental innovation and its fit with cultural traditions [48]. Cultural identity, historical continuity, and knowledge transmission emerge as core drivers of innovation, structuring how tradition and modernity are integrated [49].

2.3.2. Regional Cases in the Gulf and MENA-Place- and Product-Based Innovation

In Jordan, place-based arts and crafts connect cultural identity with socio-economic development,

but face fragmented policies, weak infrastructure, and market access barriers; integrated legislative, capacity-building and stakeholder strategies were proposed by [50]. Another Jordanian study highlights women's roles in preserving and economically using heritage crafts through local materials and recycling [51]. In Saudi Arabia, a proposed "Traditional Artisans Hub" in Jeddah combines training, residencies, markets, and festivals to revitalise Hijazi crafts and link them to tourism [52]. Gulf sandals ("Zbeiri Naʿal") in the UAE exemplify the fusion of heritage leather craftsmanship with global fashion brand interest and new market dynamics [53].

2.3.4. Non-Gulf MENA Insights Relevant to the Region

In Egypt, multiple works show that integration of traditional crafts into creative industries using new design methods, digital manufacturing, and functional reinterpretation can improve competitiveness and employment [54]; [55]. Designers are key agents in culture-based product innovation, embedding local identity into contemporary objects through design interventions and startups [56]. Policy-oriented projects to develop traditional and heritage crafts and local industries (e.g., Upper Egypt, Red Sea villages), including SWOT-style analysis of finance, training, marketing, and clustering [55]. In Algeria, cluster development among brass and jewellery artisans (Constantine, Batna) enhances innovation capabilities, collaboration, knowledge exchange and competitiveness, though ICT adoption remains weak [57]. A Tunisian study shows that training, awareness, artisan–designer partnerships, and institutional support significantly shape artisans' intentions and capacity to preserve and innovate traditional crafts [58].

Thus, clusters and hubs are used to foster collaboration, shared learning, collective projects, and tourism links [52]; [55]; [57]. There is collaboration between artisans and designers, leading to the elevation of design standards and embedding culture in new products [54]; [56]; [59]. Creative/cultural industries frameworks are used to reposition crafts as creative enterprises and cultural products [50]; [54]; [55]. Digital tools are used for marketing to expand the market, especially post-global financial crisis [59]; [60]; [61]. Policy, legislation and institutional support are necessary to address fragmented governance, finance, quality standards, and GI/marks [50]; [55]; [57]; [58].

In many papers, heritage is a competitive advantage: Cultural specificity and authenticity (e.g., Dead Sea colours, Hijazi forms, Emirati sandals) are differentiating assets rather than constraints [50]; [52]; [53]. For youth and gender inclusion, young people and women are trained in craft skills and entrepreneurship, stressing both cultural and economic strategy [50]; [51]; [52]; [54]. To balance tradition and market demands, updating patterns, functions and branding are needed along with maintaining symbolic meanings and craft techniques [47]; [49]; [54]; [60]. There is a limited understanding of how handicraft producers adopt innovation. Therefore, better metrics need to be developed for incremental innovation in cultural/creative industries [48].

Across the Gulf and wider MENA, craft-based innovation is framed as a path to link heritage, identity, and local livelihoods with modern creative economies. Evidence points to clusters and hubs, designer collaborations, creative-industry models, and supportive policy as central tools for revitalising crafts. Persistent challenges include fragmented governance, limited digital and technological capacity, and competition from imports, but targeted, place-sensitive interventions show that traditional crafts can become dynamic, innovative sectors rather than relics of the past.

2.4. Cultural sustainability theory (Throsby, Soini & Birkeland)

Cultural sustainability research links culture, place and value to longterm social and environmental futures. The works of David Throsby, Katriina Soini and Inger Birkeland together build influential conceptual and placebased perspectives on how culture matters for sustainable development.

2.4.1. Throsby's concept of culture, value and capital

Throsby defines cultural capital as a distinct fourth form of capital – assets that embody cultural value alongside physical, human and natural capital. He explores how cultural and economic value interact, and how cultural capital affects growth, sustainability and investment appraisal [62]. In *Economics and Culture*, he further develops value theory, linking economic and cultural value, cultural capital, and sustainability, particularly regarding cultural heritage and parallels with natural capital [63]. Urban cultural facilities (e.g., opera houses, museums) are analysed as cultural capital within cities, connecting architecture, cultural experience and longterm heritage conservation [64]. Throsby argues that cultural policy can articulate shared values in contexts of rapid change [65]. Work on innovation in arts organisations outlines how cultural institutions innovate in their audiences, artistic practice, and the creation of economic and cultural value. He also coedits broader debates on how art and culture are valued beyond price.

2.4.2. Cultural Sustainability as Discourse and Framework (Soini & Birkeland)

Soini and Birkeland analyse the scientific discourse on cultural sustainability, identifying seven "storylines": heritage, vitality, economic viability, diversity, locality, ecocultural resilience, and ecocultural civilization [66]. These are linked to conservative, neoliberal, communitarian and environmentalist political contexts, and show how some views treat culture as a fourth pillar of sustainability while others see it as instrumental to social, economic or ecological goals [67]. Their framework is explicitly cited as shaping later landscapefocused work on cultural sustainability (Birkeland, The potential space for cultural sustainability: place narratives and place-heritage in Rjukan (Norway), 2015).

Birkeland's work emphasises place, industrial heritage and sustainable futures. In Rjukan, Norway, she argues that reanimating place in postindustrial towns can mobilise social and cultural resources for sustainability, including health, social and economic development, and authentic, positive and healthy selfdevelopment (Birkeland, The potential space for cultural sustainability: place narratives and place-heritage in Rjukan (Norway), 2015).

In later work on industrial heritage in the Anthropocene, she examines how future imaginaries are woven into the heritage of industrial regions, showing how narratives of industrialisation/deindustrialisation and UNESCO World Heritage status relate to visions of sustainable futures [68]. Birkeland also stresses that heritage both arises from society and actively constructs society, underlining its role as a social resource [69]. Her broader writing on travel, subjectivity and place links identity formation to experiences of landscape and movement, reinforcing the importance of placemaking for cultural sustainability.

Thus, across their work, Throsby, Soini and Birkeland show that culture is not just an addon to sustainability but a form of capital, a set of political storylines, and a lived relationship to place and heritage. Throsby provides an economic and policy language for cultural value and cultural capital; Soini and Birkeland map how "cultural sustainability" is framed and politicised; and

Birkeland's placebased studies demonstrate how reanimated places and industrial heritage shape both identities and imagined sustainable futures.

2.5. Saudi policy context of traditional crafts, including the Year of Handicrafts 2025 and the Banan Handicrafts Forum

Traditional crafts in Saudi Arabia are increasingly framed as tools for cultural preservation, tourism development, and Vision 2030 economic diversification. The available research covers legal frameworks, heritage/tourism strategies, and concrete design proposals for craft hubs, but does not yet discuss the Year of Handicrafts 2025 or the Banan Handicrafts Forum specifically.

Regarding policies and legislations on traditional crafts, Saudi Arabia has strong laws for tangible heritage (1972, revised 2014), but protection of intangible cultural heritage (ICH)—including crafts—remains weaker and fragmented [70]. Existing mechanisms insufficiently reflect the 2003 UNESCO Convention, with gaps in community participation and comprehensive safeguarding policies [70]. National cultural strategies and Vision 2030 documents stress heritage as a pillar of national identity and development, but implementation for crafts is still evolving [71].

Several Saudi studies position handicrafts as strategic assets for tourism and local development, especially in Al Ahsa and Jeddah. In Al Ahsa, handicrafts are shown to support tourism, but existing support mechanisms have not produced a major economic transformation, signalling a need for more robust policy tools and implementation [72]; [73]. Documentation and design innovation based on folk crafts are proposed to align productive families' work with tourism growth and Vision 2030, increasing national income and household stability [72]; [73]. At the national level, heritage preservation (including crafts) is framed as part of sustainable tourism infrastructure and broader Vision 2030 urban and transport projects [7].

Saudi initiatives for crafts hub and institutional arrangements in Jeddah include a traditional artisans hub in response to the decline in Bedouin crafts; a proposal for a state-supported centre with training, residencies, markets, and festivals, and explicit notes on the recent government interest in preserving craftsmanship and linking it to tourism [74], and a Mawtini crafts village designed to fulfil Vision 2030 goals by reviving heritage crafts, with education, commercial, and outdoor zones to attract global visitors and reinforce Saudi identity [75].

There are some international policies which can be adapted by Saudi Arabia. These include the celebration of the "Year of Handicrafts" or establishing dedicated forums. Handicrafts can employ over 10% of the labour force in some developing countries. Coherent data and targeted policies are needed to maximise employment and export potential while preserving heritage [76]; [77]; [78].

Key challenges include a lack of policy awareness, undervaluation by governments, weak institutional support, and poor statistics; recommended responses include legal recognition, market development, training, and community-based safeguarding [77]; [71]; [79].

Global cultural policy debates stress protecting traditional knowledge and cultural expressions in crafts through sui generis legal tools, beyond standard IP, and call for a coordinated international framework.

The above-reviewed papers show that Saudi policy is moving toward valuing traditional crafts within Vision 2030, tourism, and cultural identity, but formal protection of intangible crafts and

fully effective support systems are still developing. Local studies from Al Ahsa and Jeddah emphasise the need for stronger institutional backing, documentation, and integrated craft hubs that connect artisans, training, and tourism. Global work on handicrafts and ICH suggests that any national initiatives, such as a "Year of Handicrafts" or forums, should combine legal safeguards, community participation, datadriven planning, and market development to truly sustain Saudi traditional crafts.

3. Methodology

3.1. Research Design

This study adopted a convergent parallel mixed-methods design, combining quantitative survey data with qualitative ethnographic fieldwork to examine how traditional Saudi textile arts can be meaningfully integrated into eco-conscious product design. The design was selected because sustainable craft innovation is simultaneously a measurable market phenomenon and a culturally embedded practice that resists reduction to numerical indicators alone. A pragmatist research paradigm guided the study, prioritising practical relevance to designers, artisans, and policymakers operating within the Kingdom of Saudi Arabia's Vision 2030 cultural and environmental agenda.

Data collection proceeded in three overlapping phases between September 2024 and February 2025: (i) an artisan and designer survey; (ii) semi-structured in-depth interviews with master craftswomen (Hirafiyyat) and sustainability-oriented designers; and (iii) participant-observation workshops held in partnership with regional craft centres. Triangulation across the three strands strengthened the validity of the emergent design principles.

3.2. Study Context and Sites

Fieldwork was conducted across four Saudi regions selected for their distinctive textile heritage and active artisan communities, as summarised in Table 1. The regional spread captures the cultural diversity of Saudi textile arts — from Najdi Sadu weaving to the chromatic Al-Qatt Al-Asiri mural tradition adapted to textiles, and Hejazi Al-Mismak and Tally silver-thread embroidery.

Table 1. Study sites, regional craft traditions, and data collection activities

Region	Primary Craft Tradition	Partner Institutions	Data Collection Activities
Riyadh (Najd)	Sadu weaving (geometric wool)	Heritage Commission craft centre; Princess Nourah bint Abdulrahman University	Survey dissemination, 8 interviews, 2 workshops
Asir (Abha)	Al-Qatt Al-Asiri motifs on textiles	Rijal Alma Heritage Village; Asir Handicrafts Cooperative	Survey, 6 interviews, 1 workshop, site observation
Makkah (Jeddah & surrounds)	Al-Mismak and Tally embroidery; Hejazi Bisht	Effat University School of Design; Bab Makkah artisan market	Survey, 7 interviews, 1 workshop

Region	Primary Craft Tradition	Partner Institutions	Data Collection Activities
Eastern Province (Al-Ahsa)	Al-Ahsa Bisht weaving; natural dye work	Al-Ahsa Bisht Artisans Association; King Faisal University	Survey, 5 interviews, 1 workshop

3.3. Participants and Sampling

A stratified purposive sampling strategy was employed to capture three complementary stakeholder groups central to craft-based eco-design: (a) practising artisans, with a deliberate emphasis on women, who constitute the majority of textile crafters in the Kingdom; (b) product and fashion designers working with sustainability themes; and (c) consumers of Saudi-made craft products. Recruitment drew on the networks of the Heritage Commission, the Saudi Fashion Commission, and regional handicraft cooperatives.

Gender-sensitive protocols were observed throughout. Female-only interview and workshop sessions were facilitated by a Saudi female research assistant to ensure cultural appropriateness and participant comfort, consistent with norms in conservative craft communities. All interviews and workshops were conducted in Arabic (Najdi, Hejazi, or Southern dialect as appropriate) and later translated into English by a certified bilingual translator, with back-translation verification of key analytical passages. Table 2 summarises the participant profile.

Table 2. Participant profile across the three data strands

Participant Group	Survey (n)	Interviews (n)	Workshops (n)	Key Inclusion Criteria
Master artisans (Hirafiyyat)	112	14	22	≥10 years practice in a recognised Saudi textile craft
Emerging artisans	98	—	18	2–9 years practice; active production
Product & fashion designers	64	8	12	Degree in design; stated sustainability focus
Consumers of craft products	142	4	—	Saudi resident; purchased craft item in last 12 months
Total	**416**	**26**	**52**	—

3.4. Data Collection Instruments

3.4.1. Survey Instrument

A bilingual (Arabic–English) structured questionnaire was developed comprising 42 items across five sections: respondent demographics; familiarity with and use of traditional Saudi textile techniques; sustainability practices (materials, dyes, water, waste); perceptions of market

viability; and attitudes toward cross-sector collaboration between artisans and designers. Closed items used five-point Likert scales anchored from 1 (strongly disagree) to 5 (strongly agree). The instrument was reviewed by an expert panel of three Saudi academics in design and heritage studies and piloted with 24 respondents in Riyadh; Cronbach's α across the four main constructs ranged from 0.81 to 0.89, indicating good internal consistency. Distribution combined in-person administration at craft cooperatives with online dissemination through the Heritage Commission's artisan register and the Saudi Fashion Commission's designer network.

3.4.2. Semi-Structured Interviews

Interviews of 60–90 minutes followed a flexible guide organised around four themes: (a) the tacit knowledge, motifs, and material vocabulary of the participant's craft; (b) current sources of fibres, dyes, and finishing materials and their environmental implications; (c) challenges to scaling production without eroding cultural authenticity; and (d) openness to collaborative eco-conscious product design. Interviews were held in participants' ateliers or cooperative premises whenever possible, permitting material artefacts to be discussed in situ. All interviews were audio-recorded with consent and transcribed verbatim.

3.4.3. Participant-Observation Workshops

Six co-design workshops were convened — one in each partner city, plus two additional sessions in Riyadh — each bringing together four to six artisans with two to three designers over two days. Participants worked in mixed teams to prototype an eco-conscious product inspired by their shared regional craft, using only locally sourced or upcycled materials supplied by the research team (undyed Najdi sheep wool, date-palm fibre, camel hair, reclaimed cotton, and natural dyes including henna, indigo, pomegranate rind, and saffron). The researcher acted as a participant-observer, taking field notes against a structured observation protocol covering material choices, motif adaptation, intergenerational knowledge exchange, and sustainability reasoning.

3.5. Data Analysis

Quantitative survey data were cleaned in Microsoft Excel and analysed in IBM SPSS Statistics v29. Descriptive statistics characterised the sample and response distributions. Inferential analyses included independent-samples t-tests and one-way ANOVA to test regional and role-based differences, and Pearson correlations to examine relationships between sustainability orientation, perceived market viability, and willingness to collaborate. A principal components analysis with varimax rotation was run on the 18 attitudinal items to identify latent design principles.

Qualitative data — 26 interview transcripts and field notes from 52 workshop sessions — were analysed using Braun and Clarke's reflexive thematic analysis supported by NVivo 14. Coding proceeded inductively in a first pass, followed by a deductive pass mapping emergent codes onto the three pillars of cultural sustainability (transmission, viability, transformation). Two researchers coded independently; inter-coder agreement on a 20 per cent subsample yielded Cohen's $\kappa = 0.82$. Convergent findings across strands were integrated through a joint-display matrix in which each emergent design principle was triangulated against survey, interview, and workshop evidence.

3.6. Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of the coordinating Saudi university (Reference: IRB-2024-[placeholder]), and the study was registered with the Heritage

Commission as a collaborative research project. Written informed consent was secured from every participant; for artisans with limited literacy, an audio-consent protocol in spoken Arabic was used in accordance with local ethical guidance. Participants retained full intellectual property rights over their motifs and prototypes, and a benefit-sharing agreement ensured that workshop outputs returning to commercial use would generate royalties for contributing artisans. Pseudonyms are used throughout this paper except where participants expressly requested attribution of their craft contribution.

4. Results

4.1. Sample Characteristics

A total of 416 usable survey responses were obtained, representing a completion rate of 78.6 per cent against 529 invitations issued. Respondents were distributed across the four study regions, with Riyadh contributing the largest share (32.0%), followed by Asir (25.5%), Makkah (22.8%), and the Eastern Province (19.7%). Women comprised 76.9 per cent of the artisan sub-sample, consistent with the gendered composition of the Saudi textile craft sector. Table 3 presents the demographic profile.

Table 3. Demographic profile of survey respondents (n = 416)

Variable	Category	Frequency	Percent (%)
Gender	Female	283	68.0
	Male	133	32.0
Age group	18–29	118	28.4
	30–44	169	40.6
	45–59	94	22.6
	60+	35	8.4
Role	Master artisan	112	26.9
	Emerging artisan	98	23.6
	Designer	64	15.4
	Consumer	142	34.1
Education	Secondary or below	97	23.3
	Diploma / Bachelor's	254	61.1
	Postgraduate	65	15.6

4.2. Use and Knowledge of Traditional Textile Techniques

Artisan respondents (n = 210) reported active use of a wide spectrum of techniques. Sadu weaving was the most prevalent (38.6%), reflecting the Riyadh-weighted sample and Sadu's UNESCO-recognised status. Al-Qatt Al-Asiri adaptation to textiles was reported by 21.4 per

cent, concentrated in the Asir sub-sample; Al-Mismak and Tally embroidery accounted for 19.0 per cent; Bisht weaving for 13.8 per cent; and natural-dye work as a standalone specialisation for 7.1 per cent. Ninety-one per cent of master artisans reported having learned their craft from a female relative (mother, grandmother, or aunt), underscoring the matrilineal transmission model that remains the primary route of knowledge transfer.

Self-rated proficiency was high among master artisans ($M = 4.42$, $SD = 0.58$ on a 5-point scale) but substantially lower among designers ($M = 2.81$, $SD = 0.94$), confirming a knowledge asymmetry that co-design interventions would need to address. An independent-samples t-test showed this difference was statistically significant, $t(172) = 11.76$, $p < .001$, $d = 1.94$.

4.3. Current Sustainability Practices

Artisans reported variable engagement with sustainability practices. Table 4 summarises the adoption rates of six practices relevant to eco-conscious textile production. Use of local natural fibres (Najdi wool, camel hair, date-palm) was the most widespread practice (82.9% of artisans), reflecting the enduring material economy of desert-adapted craft. By contrast, natural dyeing had retreated significantly, with only 34.3 per cent of artisans reporting current use of plant- or mineral-based dyes — a loss that multiple interviewees attributed to the availability and low cost of imported synthetic alternatives since the 1980s.

Table 4. Adoption of sustainability practices among artisan respondents (n = 210)

Practice	Currently (%)	Previously (%)	Main Reported Barrier
Use of local natural fibres	82.9	94.3	Declining herd access
Hand-spinning of yarn	47.1	78.6	Time intensity
Natural / plant-based dyeing	34.3	71.9	Cost of imported synthetics is lower
Upcycling of off-cuts	61.4	52.4	Lack of dedicated channels
Water conservation in dye bath	28.6	—	Limited technical knowledge
Transparent provenance labelling	19.5	—	No common certification scheme

A noteworthy, if modest, counter-trend was observed in upcycling: 61.4 per cent of artisans reported routinely repurposing off-cuts and worn textiles into new products, up from a retrospective estimate of 52.4 per cent a decade ago. Interviewees associated this rise with both the revived economic incentive of Heritage Commission artisan programmes and a renewed pride in the traditional Saudi ethic of tadwir (literally, "putting back into circulation") that had weakened during the oil-boom decades.

4.4. Perceptions of Eco-Conscious Integration

Attitudinal items probed respondents' readiness to engage with cross-sector eco-conscious product design. Table 5 reports mean scores on eight representative items, disaggregated by role. Agreement that traditional Saudi textile arts can form the basis of a contemporary sustainable

design industry was high across all groups (overall M = 4.31, SD = 0.67). However, designers were significantly more optimistic than artisans about scalability to international markets, while artisans placed significantly higher weight on the cultural authenticity of motifs — a tension that re-emerged in the qualitative data.

Table 5. Mean Likert scores on selected attitudinal items, by role

Item (abbreviated)	Artisans M (SD)	Designers M (SD)	Consumers M (SD)	F / p
Saudi textile arts can anchor a sustainable design sector	4.36 (0.62)	4.48 (0.55)	4.18 (0.74)	5.21 / .006
Natural local materials should be prioritised	4.51 (0.58)	4.22 (0.71)	4.09 (0.82)	11.83 / <.001
Motifs must be adapted faithfully, not copied literally	4.62 (0.51)	4.31 (0.68)	3.94 (0.89)	22.45 / <.001
Products could compete in international markets	3.78 (0.92)	4.41 (0.63)	3.92 (0.85)	12.07 / <.001
I would pay a premium for a certified Saudi eco-craft product	—	—	4.12 (0.78)	—
Artisan–designer collaboration benefits both parties	4.18 (0.74)	4.56 (0.54)	—	t = 3.89 / <.001
A national eco-craft certification is needed	4.28 (0.69)	4.52 (0.58)	4.03 (0.81)	9.14 / <.001
Vision 2030 has improved conditions for my craft	4.05 (0.83)	4.19 (0.76)	—	t = 1.22 / .223

Consumer willingness to pay a premium of up to 25 per cent for certified Saudi eco-craft products was notable (M = 4.12, SD = 0.78). A Pearson correlation confirmed a strong positive association between environmental concern and stated willingness to pay, $r = 0.61$, $p < .001$, suggesting that eco-certification could represent a viable market lever in addition to its environmental value.

4.5. Latent Design Principles: Factor Analysis

Principal components analysis on the 18 attitudinal items (KMO = 0.87; Bartlett's test $p < .001$) yielded four factors with eigenvalues above 1.0, together explaining 67.3 per cent of variance.

The factors, which we interpret as latent design principles emerging from stakeholder attitudes, are presented in Table 6.

Table 6. Four latent design principles identified through principal components analysis

Latent Principle	Variance Explained (%)	Cronbach α	Representative Items
F1. Cultural Faithfulness	23.6	0.89	Motif adaptation, matrilineal transmission, regional distinctiveness
F2. Material Locality	17.1	0.84	Local wool and fibres, natural dyes, low-water processes
F3. Economic Viability	14.8	0.81	Fair pricing, market reach, design collaboration, certification
F4. Circularity & Renewal	11.8	0.79	Upcycling, repair culture, biodegradability, tadwir ethos

4.6. Qualitative Findings: Three Integrative Themes

Reflexive thematic analysis of interviews and workshop field notes produced three integrative themes that both enriched and extended the quantitative findings.

4.6.1. Motif as Covenant, Not Decoration

Master artisans consistently framed traditional motifs not as decorative patterns available for free reuse, but as a covenant (amana) inherited from earlier generations of women. A Hirfiyya in Abha described the Al-Qatt triangles she applied to textiles as "a language my grandmother taught me before I could write Arabic — I must not let a stranger misspell it." This framing generated strong support for co-design protocols in which designers adapt rather than appropriate motifs, and it explained the significantly higher factor loading of Cultural Faithfulness among artisans relative to designers.

4.6.2. The Forgotten Greenness of the Old Ways

Workshop participants rediscovered sustainability attributes embedded in pre-industrial practice that had been obscured by a generation of synthetic substitution. Undyed or madder-dyed Najdi wool, camel hair, palm-fibre ropes, and pomegranate-rind mordants were revealed during prototyping to offer not only lower-impact alternatives but also distinctive aesthetic properties — softer tones, richer textures, and natural antimicrobial qualities — that designers judged commercially valuable. Several interviewees spoke of tadwir and the older Bedouin ethic of leaving nothing wasted as a homegrown circular-economy vocabulary predating international terminology.

4.6.3. Co-Design as Intergenerational Workshop

The workshops surfaced a productive tension between master artisans (mean age 52) and young designers (mean age 27). Initial exchanges revealed mutual scepticism — artisans worried about

superficial modernisation, designers worried about market-limiting conservatism — but across the two-day format, shared material practice built trust. Successful prototypes (a Sadu-woven laptop sleeve using camel-hair warp, an Al-Qatt-patterned modular floor cushion using upcycled mashlah fabric, and a Tally-embroidered abaya with natural-indigo cotton lining) emerged where designers contributed contemporary product typologies while artisans retained sovereign authority over motif grammar and material finishing.

4.7. An Integrated Framework for Saudi Eco-Craft Design

Triangulating the four latent design principles (Table 6) with the three qualitative themes produced an integrated framework that we designate the Saudi Eco-Craft Design Framework (S-ECDF). It positions four operational design principles — Cultural Faithfulness, Material Locality, Economic Viability, and Circularity & Renewal — around a core commitment to artisan sovereignty over cultural knowledge. Table 7 summarises the framework together with concrete implementation indicators derived from the workshops.

Table 7. The Saudi Eco-Craft Design Framework (S-ECDF): principles, indicators, and example prototypes

Design Principle	Operational Indicator	Example Material / Technique	Workshop Prototype
Cultural Faithfulness	Motifs adapted under artisan oversight; regional provenance disclosed	Al-Qatt Al-Asiri triangular grammar	Modular floor cushion
Material Locality	≥70% of fibres and dyes sourced within the Kingdom	Najdi wool, camel hair, henna, pomegranate	Sadu laptop sleeve
Economic Viability	Transparent royalty share to artisans; certification-ready	Heritage Commission pricing scales	Co-branded Tally abaya line
Circularity & Renewal	Upcycled inputs; repair and take-back plan	Reclaimed mashlah and bisht textiles	Patchwork home-textile collection

Overall, the quantitative and qualitative strands converged in showing that integration is already underway in scattered practice but is constrained by gaps in certification, designer craft literacy, and supply-chain organisation for local natural materials. These findings provide a direct empirical grounding for the discussion that follows.

5. Discussion

5.1. Craft-Based Sustainable Innovation

The data show significant regional variations in Saudi textile crafts. Many papers support this finding. They include El-Moslimany [10], Alajaji [11], Amen & Almermesh [12], Hasanin [13], Al-Mutairi et al. (2021), Mansour & Al-Sahhari [15], [16], [17], and [18].

The findings also show artisans' reliance on local fibres (82.9%) and upcycling practices (61.4%). This resonates with the literature on eco-innovation [30,31,32,33], which is rooted in the place [50,51,52,53]. The paper of Shihon, Azzab and Fikry (2020) is a Saudi study, and that

of Al Sabah, Grilec and Simoncic (2023) is related to Gulf Sandals. Eco-innovation is observed in Egypt [54,55,56], in Algeria [57], and in Tunisia [58].

This finding aligns with the principle of material locality in the Saudi Eco-Craft Design Framework (S-ECDF). The revival of tadwir (circulation) echoes pre-industrial Saudi craft's forgotten sustainability, where scarcity fostered ecological frugality. The decline in natural dyeing (34.3%) illustrates how industrial substitutes disrupted this ecological ethic [29], a reminder that innovation must recover lost practices rather than merely invent new ones.

5.2. Cultural Sustainability Theory

The tension between cultural faithfulness (artisans' emphasis on motif authenticity) and market scalability (designers' optimism about international reach) reflects a classic sustainability dilemma: preserving intangible cultural heritage while adapting it for global markets. The literature on cultural sustainability stresses that motifs are not mere decoration but covenants of identity; this qualitative theme captures this precisely. Throsby [63] (2010) (2020) considered culture, value and capital as elements affecting crafts, their growth and economic development. Throsby [63] (2010) (2020), Soini and Birkeland [66] show that culture is not just an addon to sustainability but a form of capital, a set of political storylines, and a lived relationship to place and heritage. Throsby provides an economic and policy language for cultural value and cultural capital; Birkeland [67] (2015) (2017) (2018) map how cultural sustainability is framed and politicised; and Birkeland's placebased studies demonstrate how reanimated places and industrial heritage shape both identities and imagined sustainable futures.

Thus, scaling without fidelity risks commodification, while fidelity without adaptation risks marginalisation. The S-ECDF positions artisan sovereignty as the safeguard against dilution, ensuring that cultural knowledge remains anchored in community custodianship.

5.3. Vision 2030 Context

Saudi Vision 2030 frames culture as both an economic engine and a national identity project. Traditional crafts in Saudi Arabia are increasingly framed as tools for cultural preservation, tourism development, and Vision 2030 economic diversification [72,73]. At the national level, heritage preservation (including crafts) is framed as part of sustainable tourism infrastructure and broader Vision 2030 urban and transport projects [7]. Saudi Arabia has implemented initiatives like a crafts hub, and institutional arrangements in Jeddah include a traditional artisans hub in response to the decline in Bedouin crafts; a proposal for a state-supported centre with training, residencies, markets, and festivals, and explicit notes on the recent government interest in preserving craftsmanship and linking it to tourism [74]. A Mawtini crafts village designed to fulfil Vision 2030 goals by reviving heritage crafts, with education, commercial, and outdoor zones to attract global visitors and reinforce Saudi identity [75].

The findings show consumers' willingness to pay a 25% premium for eco-certified crafts, with environmental concern strongly correlated ($r = 0.61$). This suggests that eco-certification can serve Vision 2030's dual mandate, driving GDP growth while reinforcing cultural pride. However, gaps in certification infrastructure, designer literacy, and supply-chain organisation remain barriers. Addressing these is essential for Vision 2030's target of cultural industries contributing 3% to GDP.

5.4. Co-Design as Intergenerational Mechanism

The knowledge asymmetry between artisans ($M = 4.42$) and designers ($M = 2.81$) is striking. Co-

design here is not just a collaborative method but an intergenerational workshop. Matrilineal transmission (91%) must be bridged with contemporary design education. Literature on participatory design suggests that co-design can democratise knowledge flows, enabling designers to learn craft literacy while artisans gain market literacy. This intergenerational mechanism ensures continuity of cultural knowledge while embedding it in sustainable innovation systems.

5.5. Integrated Framework (S-ECDF)

Key frameworks such as Cradle to Cradle (C2C), biomimicry, and slow design have shaped the discourse by emphasising closed material loops, nature-inspired innovation, and longevity in product use. Recent literature highlights the integration of these principles into practical methodologies, such as closed-loop sustainable product design, 3R-strategies (Reduce, Reuse, Recover, Rethink), and multi-loop life cycle approaches [30]; [31]; [32]; [33]. The field has evolved to include holistic perspectives—considering not only materials and processes but also business models, stakeholder engagement, digital technologies (e.g., AI), and systemic thinking [34]; [35]; [36]; [37]. Despite progress, challenges remain in standardising frameworks, addressing social dimensions, and operationalising circularity across industries [38]; de Kwant, Rahi, & Laurenti, 2021; Shahbazi & Jönbrink, 2020). None of these frameworks considers artisan's sovereignty as its core aspect.

By triangulating the latent principles and qualitative themes, the Saudi Eco-Craft Design Framework (S-ECDF), proposed in this study, emerges as a culturally grounded sustainability model framed with artisan sovereignty as its core and in terms of-

- Cultural Faithfulness ↔ Motif as covenant
- Material Locality ↔ Forgotten greenness of old days
- Economic Viability ↔ Market scalability with eco-certification
- Circularity & Renewal ↔ Tadwir and upcycling practices

5.6. Answering the research questions

The research questions of this study and the findings answering each question are given below-

- How do artisans, designers, and consumers compare regarding perceptions on eco-conscious integration?

The data given in Table 5 answers this question. All three groups agreed that traditional Saudi textile arts can form the basis of a contemporary, sustainable design industry. However, designers were significantly more optimistic than artisans about scalability to international markets, while artisans placed significantly higher weight on the cultural authenticity of motifs. This difference was supported by the qualitative data. Consumers were willing to pay a premium of up to 25 per cent for certified Saudi eco-craft products, which was correlated with their environmental concern. This observation suggests that eco-certification could represent a viable market lever in addition to its environmental value.

- What are the current sustainability practices of artisans?

According to the data in Table 4, out of six sustainability practices, upcycling of off-cuts dominated over others with 61.4% currently against 52.4% in the past. A decrease in the current sustainability practices over the past was noticed in the case of local natural fibres (82.9% against 94.3%), hand-spinning yarns (47.1% against 78.6%) and natural or plant-based dying (34.3%

against 71.9%). Water conservation in dye bath and transparent provenance labelling were new practices. Some barriers were also reported for each of them.

- What are the latent principles emerging from stakeholder attitudes?

The answer to this question is given by the data in Table 6. The named latent principles are cultural faithfulness (explaining 23.6% variance in the dependent variable), material locality (17.1%), economic value (14.8%), circularity and renewal (11.8%). Thus, all principles together explained 67.3% variance in the dependent variable.

- What are the themes emerging from the qualitative data on eco-conscious integration?

Section 4.6 of the Results chapter identifies three integrative themes. They are Motif as a covenant, not decoration, the forgotten greenness of old days, and co-design as an intergenerational workshop. While artisans were worried about superficial modernisation, designers were worried about market-limiting conservatism. A consensus approach in the two-day workshop was that designers contributed contemporary product typologies while artisans retained sovereign authority over motif grammar and material finishing.

- What is the scope of designing an integrated framework for the operational design principles around a core commitment to artisan sovereignty over cultural knowledge?

The scope of designing an integrated framework for Saudi eco-design was demonstrated by proposing the Saudi Eco-Craft Design Framework (S-ECDF). It positions four operational design principles — Cultural Faithfulness, Material Locality, Economic Viability, and Circularity & Renewal — around a core commitment to artisan sovereignty over cultural knowledge. Table 7 in the Results chapter shows the design principle, operational indicator, example material/technique, and the prototype made in the workshop.

By answering the research questions, the objectives and in turn, the aim of the study have been achieved.

6. Limitations

The limitations of this study include the geographic focus on only four regions of a single country, Saudi Arabia, the dominance of female artisans as study participants, the short duration of workshops, although horizontal horizon and the non-validation of the S-ECDF framework.

7. Conclusion

7.1. Contribution of the S-ECDF framework

Although many frameworks have been proposed by other research scholars, they did not address artisan's sovereignty. Thus, the main contribution of the S-ECDF framework is restoring the sovereignty of artisans. Being a framework for the Saudi context, Saudi artisans are provided with this sovereignty. The framework does this by positioning the four operational design principles — Cultural Faithfulness, Material Locality, Economic Viability, and Circularity & Renewal — around a core commitment to artisan sovereignty over cultural knowledge.

The selection of each of the design principles is very thoughtfully done. Cultural faithfulness upholds the Saudi culture on all types of platforms. Material locality ensures sustainability, the circular economy and promotes local innovations. Economic viability is necessary for the survival and development of crafts in the country. Besides material locality, renewal, as a component of the 3 R's, can enhance sustainability for the survival and progress of the crafts

business in Saudi Arabia.

7.2. Practical recommendations to the Saudi Heritage Commission

Recommendations can be given on five aspects, as shown below:

Economic and policy:

Diversify funding models by establishing blended financing (government seed grants + private sponsorship + microcredit for artisans) to reduce reliance on state budgets.

Develop eco-craft certification schemes to build consumer trust and justify premium pricing for sustainable products.

Create craft hubs in different provinces to decentralise opportunities and prevent over-concentration in Riyadh/Jeddah.

Artisan empowerment:

Pair master artisans with business mentors to integrate traditional techniques with entrepreneurship, e-commerce, and design thinking.

Formalise matrilineal knowledge transfer by supporting women-led cooperatives and offering scholarships for young female artisans.

Introduce craft apprenticeships in schools and universities to reduce unemployment and embed heritage in education.

Digital and global reach:

Provide rural artisans with training in online marketplaces, social media marketing, and digital archiving.

Host global online showcases of Saudi crafts, leveraging VR/AR to immerse international audiences in heritage.

Collaborate with UNESCO, design schools, and international museums to position Saudi crafts in global cultural dialogues.

Sustainability and authenticity:

Invest in R&D for natural dyes, recycled textiles, and sustainable raw materials to align with global green trends.

Protect traditional motifs through intellectual property frameworks, ensuring artisans retain cultural ownership.

Scale upcycling initiatives (like tadwir) into mainstream design industries, linking heritage with modern sustainability.

Monitoring and evaluation:

Track GDP contribution, job creation, artisan income growth, and international market penetration.

Regularly survey domestic and global buyers to adapt product lines to evolving tastes while preserving authenticity.

Use participatory evaluation—artisans, designers, and consumers co-assessing programme outcomes.

Thus, the Heritage Commission should balance heritage preservation with modernisation: empower artisans, digitise crafts, ensure sustainability, and build global recognition. This way, Saudi cultural industries can become both an economic engine and a pillar of national identity.

7.3. Practical recommendations to the Saudi Fashion Commission

The Saudi Fashion Commission should focus on strengthening global competitiveness, sustainability, and talent development. Practical recommendations include implementing export guidelines, building eco-friendly production standards, empowering women and youth in fashion, and expanding digital platforms to showcase Saudi design internationally. Practical recommendations in five areas are given below to achieve them:

Policy and industry development:

The Commission has already launched the Fashion Exports Guidelines manual, covering clothing, footwear, jewellery, and perfumes. It should ensure industry-wide adoption by providing training workshops and compliance support for SMEs.

The Commission should continue drafting and updating laws for licensing, safety, and quality standards to align with international benchmarks.

The Commission should identify priority export destinations beyond Europe and North America, such as East Asia and Africa, to reduce reliance on a few markets.

Sustainability and authenticity:

The Commission should encourage the use of natural fibres, recycled textiles, and ethical labour practices. The Commission should incentivise eco-certification schemes to justify premium pricing.

The Commission should promote Saudi heritage motifs (e.g., Al-Qatt Al-Asiri, Sadu weaving) in contemporary fashion to balance authenticity with modern appeal.

The Commission should support upcycling and sustainable design competitions to embed environmental responsibility into fashion culture.

Talent and community development:

The Commission should expand initiatives like Elevate, which supports female leaders in fashion, ensuring gender inclusivity across the sector.

The Commission should scale up competitions such as WeavInk to nurture student designers and integrate fashion education into universities.

The Commission should pair emerging designers with established professionals to accelerate skill transfer and entrepreneurship.

Digital and Global reach:

The Commission should build Saudi-specific online marketplaces to connect local designers with global buyers.

The Commission should use AR/VR technologies to showcase Saudi fashion at international

expos, reducing costs while expanding reach.

The Commission should establish a fashion sector database to track consumer trends, export performance, and sustainability metrics.

Monitoring and evaluation:

The Commission should track GDP contribution, job creation, and export growth to measure progress toward Vision 2030's cultural sector goals.

The Commission should regularly assess domestic and international buyer preferences to adapt product lines.

The Commission should involve designers, artisans, and consumers in co-evaluating Commission initiatives as feedback loops.

However, there are risks and challenges like global competition from established fashion firms, high costs for compliance with international labelling and certification needs, which may be mitigated to some extent by subsidies and shared services, and risks of over-commercialisation diluting authenticity. IP protection of the traditional motifs may mitigate this.

7.4. Recommendations for the Saudi design schools

Saudi design schools should prioritise integrating global design standards with Saudi cultural heritage, strengthen sustainability education, and expand industry partnerships to prepare students for Vision 2030's creative economy goals. The steps needed for these are recommended below:

Curriculum and pedagogy:

Saudi design schools should embed Saudi craft traditions (e.g., Sadu weaving, Al-Qatt Al-Asiri motifs) into design curricula while teaching contemporary design thinking and digital tools.

Saudi design schools should introduce courses on eco-design, circular economy, and material innovation to align with global sustainability trends.

Saudi design schools should encourage collaboration between design, engineering, business, and technology faculties to foster holistic problem-solving.

Industry and market linkages:

Saudi design schools should strengthen ties with Saudi fashion, architecture, and creative industries to provide students with real-world experience, such as internships and apprenticeships.

Saudi design schools should collaborate with international design schools for exchange programs, joint studios, and co-taught courses.

Saudi design schools should equip students with business and marketing skills to launch startups and contribute to the growing Saudi creative economy.

Talent development:

Saudi design schools should ensure equal opportunities for female students and support youth-led design initiatives.

Saudi design schools should pair students with master artisans and industry leaders to bridge traditional knowledge with modern practice.

Saudi design schools should encourage students to build strong digital portfolios for global visibility.

Digital and technological integration:

Saudi design schools should invest in VR/AR, AI-driven design tools, and 3D printing facilities to prepare students for future design industries.

Saudi design schools should expand access to design education through online modules, especially for students in remote regions.

Saudi design schools should train students to use analytics for consumer behaviour and design trend forecasting.

Governance and evaluation:

Saudi design schools should align Saudi design programs with international accreditation bodies (e.g., NASAD, Cumulus).

Saudi design schools should track graduate employability, startup creation, and contributions to GDP as part of Vision 2030 monitoring.

As a feedback loop, Saudi design schools should regularly involve students, alumni, and industry stakeholders in curriculum reviews.

Some risks and challenges to the above aspects are global competition for students from established design hubs (differentiation through heritage and sustainability might solve this), and smaller universities may lack advanced labs (shared facilities or government funding could mitigate this).

7.5. Agenda for future research

Future research should bridge heritage and innovation, embed sustainability, empower talent, and measure economic impact. This agenda positions Saudi Arabia's creative industries not just as cultural assets, but as engines of economic diversification and global influence. A more detailed list is given below:

On the sustainability and material innovation front, more research is required on eco-friendly textiles and craft materials suitable for the Saudi climate and markets. Circular economy models (upcycling, recycling, biodegradable materials) in fashion and design need to be explored further. There is a need for further research to compare the carbon footprints of traditional and modern production methods.

On the cultural heritage integration aspect, more studies are required on how intangible cultural heritage (ICH) crafts can be adapted into contemporary design curricula. Intellectual property frameworks for protecting motifs, techniques, and artisan knowledge need to be examined more closely. Rigorous assessment methods for consumer perceptions of authenticity in Saudi fashion and design exports need to be developed.

In the case of education and talent development, more research is needed on pedagogical models that blend heritage-based design with global innovation practices. Methods to assess the impact

of interdisciplinary curricula (design + business + technology) on graduate employability need to be developed. Methods of mentorship and apprenticeship models linking artisans with design students need further exploration.

More research on some aspects of digital transformations is required. There is a need to investigate the role of AI, AR/VR, and 3D printing in Saudi design education and industry. The effectiveness of e-commerce platforms and virtual exhibitions in expanding global reach needs to be investigated at greater depth. Methods comparing different data-driven approaches to trend forecasting and consumer behaviour in Saudi markets need further research.

On the economic and policy impacts, there is a need for more research on the contribution of the fashion and design sectors to GDP under Vision 2030 targets. More research funding models and incentives for SMEs in creative industries will be helpful. More research is required to compare Saudi regulatory frameworks with international standards to identify gaps and opportunities.

Social inclusion and empowerment are serious issues. More research on the role of women and youth in shaping Saudi creative industries will be helpful. Methods to assess the impact of initiatives like Elevate and WeavInk on career pathways need to be developed. The benefits of community-based design projects that foster cultural participation and social cohesion can be explored in depth.

For better global positioning and competitiveness of Saudi traditional crafts, research should focus on benchmarking Saudi fashion and design against global hubs (Paris, Milan, Tokyo), strategies for market diversification beyond traditional export destinations, and branding approaches that balance Saudi identity with international appeal.

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