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Integrating Saudi Architectural Motifs into Sustainable Product Design: A Framework for Cultural Preservation and Innovation

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Abstract

Research problem: A research gap exists regarding factors affecting consumer acceptance of sustainable products designed with cultural motifs. This study aimed to investigate consumer acceptance of sustainable products designed with cultural motifs by examining regional recognition differences, demographic influences, sustainability awareness, and design feasibility; to identify market-readiness factors and barriers to implementation; to explore innovation pathways for culturally integrated product development; and to assess expert validation of the proposed cultural-sustainable design framework. Methodology: A survey of 384 Saudi nationals and semi-structured interviews with 12 experts. Key findings: Consumer acceptance of sustainable product design in Saudi Arabia is most strongly driven by recognition of cultural motifs and sustainability awareness, with regional heritage traditions (e.g., Al-Qatt Al-Asiri) playing a key role. While consumers currently prioritise cultural visibility and ecological responsibility, experts emphasise that innovation capacity will be decisive for future scalability-aligning directly with Saudi Vision 2030's goals of cultural preservation, sustainability, and industrial diversification. Implications for integrating Saudi architectural motifs into sustainable product design: Heritage should be treated as both a creative source and a sustainability strategy, with Saudi architectural motifs embedded into adaptable design systems and sustainable product lifecycles. By aligning with Vision 2030, designers, industry, cultural institutions, and policymakers can transform motifs from static heritage into dynamic innovation resources-preserving identity, fostering ecological responsibility, ensuring global competitiveness, and positioning Saudi Arabia as a leader in cultural-sustainable product design through coordinated action across culture, industry, education, and tourism.

Keywords: *Saudi architectural heritage, sustainable design, cultural preservation, product innovation, Vision 2030, Mashrabiyya, Al-Qatt Al-Asiri*

Introduction

Background of Saudi Architectural Heritage and Its Cultural Significance

The architectural heritage of Saudi Arabia is diverse, climate-responsive, and culturally rooted. People commonly use local materials like mud-brick, stone, and wood to create sustainable, private, and community-focused environments. This is significant for reflecting Islamic values and social structures. Before the beginning of the oil era (1930's), local, manual labour and specialised, environmentally attuned methods were passed down through generations.

There are also regional identities like Najdi clay structures, Hijazi coral stone buildings, Asir high-altitude stone buildings, historically adorned with colourful, geometric, and artistic patterns known as Al-Qatt Al-Asiri and Nabataean Architecture of ancient, sophisticated rock-cut tombs and temples found in Al-Ula, dating back to pre-Islamic civilisations. However, modern

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adaptations like Salmani architecture aim to balance modern technological innovation with traditional Saudi identity, blending the old with the new. According to (Abowardah, 2025), integrating traditional architecture with modern technology enhances national identity, authenticity, and modernity.

The 1950s–70s saw a rise in international concrete styles, but a resurgence in valuing local heritage began in the 1980s. Current initiatives include preserving old villages and integrating elements like mashrabiyas into modern buildings to harmonise the past with the future, often using metaverse technologies (PwC, 2024).

The key architectural elements of Saudi Arabia are Mashrabiya: Ornate wooden latticework screens that provide privacy and shade while allowing airflow; Arches and Domes: Graceful arches and domes that signify grandeur and spiritual significance; Ornate Doors and Windows: Intricately carved wooden doors and windows that serve as both functional and decorative elements; Decorative Tiles and Mosaics: Colourful tiles and mosaics that adorn walls, floors, and fountains, adding aesthetic beauty and cultural symbolism, and Courtyards: Central courtyards that act as private outdoor spaces, fostering social interaction and offering respite from the heat (Bronzeeheritage, 2024).

The Intersection of Cultural Preservation and Sustainable Design

The Saudi Heritage Commission has initiated steps to register 50,000 sites as architectural heritage sites as the first step to preserve the Saudi heritage architecture (Al-Thaqafi, 2023). (Alzhrani, 2025) highlighted the usefulness of digital art to modernise the Saudi architectural heritage. (Anifowose, et al., 2024) discussed the conflict between preserving culture and promoting economic development with respect to Nigeria, using document analysis. (Gonzales, 2025) systematically analysed case studies related to renewable energy, sustainable agriculture, urban planning, and digital technologies. The author identified three primary intersection patterns. They included ethical-cultural alignment in innovation design, cultural adaptation of sustainable technologies, and value-based innovation frameworks that integrate environmental, social, and ethical considerations. Thus, successful sustainable innovations require navigation of complex relationships between universal ethical principles and particular cultural contexts. It should also address environmental challenges with respect to cultural diversity and promote social justice. A case study of a South Indian temple architecture by (Chandran & Chon, 2021) showed that design-based techniques in the field of heritage preservation should aim at a level of transferability across the dimensions of interdisciplinary collaboration to generate more meaningful and sustainable impact. This challenges the current hierarchical, expert-driven ecosystem. However, it facilitates the possibility of directly involving the community in initiating a cycle of large-scale changes in cultural policies.

Saudi Vision 2030 and Its Emphasis on National Identity and Sustainability

Currently, in Saudi Arabia, the most recent architectures reveal an emergent national attempt to reconceptualise the term ‘heritage’ within an approach that focuses on socio-cultural sustainability alongside new urban development. There is an effort to align this with the Saudi Vision 2030 (SaudiArabia, 2016). (Maqbool, Hina, Malik, & Arslan, 2024) explored the role of the Red Sea Global project in shaping Saudi Arabia’s tourism industry in relation to its national identity and the objectives of Vision 2030. The project focuses on preserving the sustainability

and cultural heritage of Saudi Arabia. Using a thematic approach, the authors showed that the project catalyses the modernisation of Saudi Arabia's image and reinforcement of its traditional values. The initiative supports national goals and promotes Saudi Arabia's international stature by integrating modern global trends with local cultural elements. The interactions between tourism development and national identity are complex. It reveals the broader implications for Saudi Arabia's socio-economic and cultural landscape. However, the Vision 2030 may eliminate the national identity of Saudi Arabia as a strong Islamic conservative state due to the policy of openness arising from the Vision (Winarni & Permana, 2022). (Aldossry, 2024) noted that Saudi Arabia is delicately balancing the conflict between tradition and progress, addresses the challenges to its identity, and ensures inclusivity and diversity through its Vision 2030. Although its citizens initially did not accept the celebration of the Saudi National Day, they are now accepting it. Thus, the government plays a pivotal role in guiding society's shift from conservatism to modernity. Using a case study of Ushaiger Village, (Mazzetto, 2024) showed that caring for heritage sites can promote economic development and environmental sustainability, providing a model for integrating cultural heritage into Vision 2030. Through an exhaustive and critical integrative review of multiple documents, (ldosari, 2026) showed that three significant policy changes were made by Vision 2030. Firstly, it has enhanced the visibility of environmental sustainability. Secondly, it has built a more differentiated institutional architecture. For this, it has used the National Environment Strategy, the 2020 Environmental Law, specialised environmental centres, and green-finance mechanisms. It has also connected environmental policy to economic diversification, quality of life, and international positioning.

Integrating Saudi Architectural Motifs into Sustainable Product Design

(Alghamdi & Al-Ashwal, 2025) examined the sustainability of Islamic decorative arts by analysing the symbolic, cultural, and spiritual dimensions of botanical motifs in Makkah's architectural heritage. Findings reveal that elements such as palm trees and pinecones embody universal archetypes of resilience and growth, while their abstraction and harmony symbolise divine unity. These motifs are not merely ornamental but integral to architectural identity, offering rich potential for cultural tourism and educational initiatives. Yet, rapid urbanisation poses significant challenges, underscoring the urgent need for systematic documentation and innovative preservation strategies.

(Al-Mutairi, Al-Zahim, Al-Thumairi, Al-Omar, & Al-Wassel, 2021) aimed to study the design of modern and innovative textiles inspired by Saudi traditional symbols to attract adolescents and connect them to their cultures. They also aimed to revive these symbols to address rapid cultural and trend developments. The authors experimented with Saudi architecture, including details of doors, windows, archaeological drawings on walls, and the symbols of "Al-Qatt Al-Assiri" (a national costume), to utilise them in the digital design program Illustrator. The goal was to formulate, adapt, and produce different designs, considering the basics and elements of both textile and graphic design. The results showed that creating numerous decorative designs characterised by modernity and originality is possible through analysing traditional symbols. Saudi art, rich in linear rhythm values, offers artists and designers a deep well of inspiration to explore aesthetic dimensions. Popular art traditions in Saudi Arabia and Egypt, full of diverse decorations, further enhance fashion and textile design. By refining and reintroducing heritage values, these symbols can be foregrounded in creative processes, providing designers with options that display their artistic heritage through vibrant colours of art and literature. Fashion

and textile design thus play essential roles in fostering and maintaining national identity by integrating traditional symbols and decorations into contemporary designs. Simultaneously, there is an urgent need to safeguard popular symbols from disappearance and extinction, due to their positive role in reinforcing cultural identity. This aligns with the main aim of the research: to move beyond conventional design systems in textile design through overlapping and repetition. Developing decorative designs based on repetition and fundamental design principles can generate unprecedented artistic and aesthetic values, enriching the wider field of design.

(Hanafy & Al-Rashoud, 2024) aimed at integrating heritage elements into women's tourism product design, focusing on preserving Saudi cultural heritage and empowering women. The results of surveys, literature review and participant feedback showed an emphasis on consumers' high valuation of heritage elements, recognising their role in enhancing authenticity, aesthetics, and gift suitability. Areas for improvement were product allure and manufacturability.

Fashion design in Saudi Arabia is deeply shaped by ethnic influences, reflecting the nation's rich cultural heritage and diverse regional identities. (Almeshari, 2026) investigated how cultural traditions inform fashion across different regions, focusing on the ways regional and tribal norms have influenced traditional clothing styles, symbolic motifs, and consumer preferences. Using semi-structured interviews and thematic analysis with ten Saudi designers from various regions, the research found that regional and tribal norms are not only respected but actively represented in contemporary Saudi fashion. These cultural influences extend beyond design choices, shaping marketing strategies for new collections and reinforcing the role of fashion as a medium for cultural continuity.

(Hamid, et al., 2024) aimed to investigate the potential for utilising Arabic calligraphy and the symbols of Islamic architecture to enrich the aesthetic values of metal painting. The authors analysed 12 metal paintings, describing their content and components using the study variables. The results indicated the possibility of a benefit from linear systems in creating metal panels with diverse aesthetic values. These systems have adequate diversity to generate formal and expressive relationships in combination with the elements and symbols of Islamic architecture. Thus, they are suitable as a primary basis for the design and construction of metal paintings. The linear system also contributed to achieving multiple functions with the metal painting and enhancing artistic values in general.

Research Gap and Problem Statement

Although the PwC report discusses the use of metaverse technology to preserve and modernise ancient villages, it does not mention similar approaches for developing new product lines. None of the papers on the intersection of cultural preservation and sustainable design address the preserved heritage, digital art, innovation, or interdisciplinary collaboration in new product design and development. Aligning cultural heritage with Vision 2030 should encompass all relevant factors related to economic growth. The development of new products as part of this alignment has not received sufficient attention. This paper explores the integration of Saudi architectural motifs with sustainable product development. The new products mentioned in the five papers reviewed were limited to items such as Islamic decorative arts, fashion design and textiles aimed at adolescents, metal artwork, and women's tourism promotion. Innovative designs for commonly used products were not considered.

Aim, Research Questions and Objectives

Aim: To investigate consumer acceptance of sustainable products designed with cultural motifs by examining regional recognition differences, demographic influences, sustainability awareness, and design feasibility; to identify market-readiness factors and barriers to implementation; to explore innovation pathways for culturally integrated product development; and to assess expert validation of the proposed cultural-sustainable design framework.

Research Questions:

1. To what extent can cultural motifs predict consumer acceptance?

2. To what extent can sustainability awareness predict consumer acceptance?

3. To what extent can the feasibility of design integration predict consumer acceptance?

4. To what extent can innovation potential predict consumer acceptance?

5. To what extent can a cultural preservation attitude predict consumer acceptance?

6. How do regional differences impact cultural motif recognition (CMR)?

7. How do demographic factors impact consumer acceptance, sustainability awareness, and design integration feasibility?

8. What are the factors determining the market-readiness of products designed based on cultural motifs?

9. What are the barriers to implementing product development based on cultural motifs?

10. What innovation pathways can be used to develop products based on cultural motifs?

11. What is the extent of acceptability of the framework of cultural-sustainable product design among experts?

Significance of This Study

This study aimed to explore the various factors related to the integration of the Saudi cultural motifs with sustainable product development. Research on incorporating Saudi architectural motifs into sustainable product design is important because it connects cultural heritage with contemporary sustainability efforts, strengthening identity while encouraging eco-friendly innovation. It guarantees that traditional aesthetics are maintained and reinterpreted to meet global sustainability objectives. The study contributes in four ways: preservation of the Saudi culture, sustainable innovation, economic value and social values. Saudi architecture has rich motifs like Najdi doorways, Tarma Alfuraj, and Shuraf, incorporating centuries of craftsmanship and symbolism. This research identified seven architectural motifs suitable for sustainable product design. When these motifs are integrated into products, there is a continuity of the country's cultural identity in daily life. This prevents erosion of the heritage due to globalisation. There is a possibility of adapting motifs into eco-friendly, energy-efficient designs and circular product lifecycles. Such sustainable adaptation aligns with the Saudi Vision 2030, which stresses sustainable cultural revival. When tradition is blended with sustainability in products, they appeal

to both local and global customers. This promotes creative industries, branding and tourism, highlighting the uniqueness of Saudi Arabia.

Investigation of factors such as awareness, attitudes, regions, and demographics helps understand customers' responses to products and their integration of cultural motifs. Similarly, identification of barriers can lead to proactive strategies to minimise their impact. Innovation is an important aspect when cultural motifs are integrated into products. The study of innovation pathways is useful for designing sustainable products based on Saudi cultural motifs.

The findings of this study were used to propose and validate a framework by referring to experts. The framework can be used/adapted to other contexts of cultural motifs for similar gains.

Structure of This Paper

After this section, section 2 reviews the relevant literature. Section 3 outlines the methodology used for data collection and analysis. Section 4 presents the results from the methodology used. Section 5 discusses and interprets the findings. Section 6 concludes the paper by summarising the results and offers recommendations for future research and various stakeholders.

LITERATURE REVIEW

Saudi Architectural Heritage and Its Design Language

(Erqsous, 2022) used five case studies of Saudi institutions that use elements and symbols inspired by the heritage of cities in Saudi Arabia through their logos and visual identities. The results showed the effectiveness of corporate identities in preserving the characteristics of Saudi cities and the nature of the elements used in documenting the architectural and cultural heritage of each city. Also discussed is the important role of tangible products in promoting a place and its heritage.

(Alnaim & Alnaim, 2026) explored methods used for the strategic integration of traditional Saudi vernacular architecture into contemporary urban development as a culturally grounded and sustainability-oriented design approach, avoiding a mere symbolic or aesthetic reference. The authors used a convergent mixed-methods design, integrating comparative case study analysis with primary data from expert interviews and structured survey questionnaires administered to residents and visitors. The results showed that cultural integrity is strengthened when projects meaningfully integrate local sustainability principles like climate-responsive construction, spatial hierarchy, and material authenticity. These strategies lead to enhanced environmental performance and increased public acceptance of urban transformation. Thus, modernisation can go hand in hand with specific policy-guided frameworks of heritage preservation and community engagement mechanisms.

A survey of 787 participants by (Ashour, 2020) revealed that most of them were severely concerned about the gradual decline in the authentic architectural identity in contemporary architecture in Medina. Visual privacy, functional performance, and aesthetic appearance were the most important concerns in their selection of window shading type. Most of them noted that Rowshan was more effective in covering home windows for achieving satisfying levels of aesthetic appearance, visual privacy, and daylight at homes compared with contemporary

windows. They were also concerned about the gradual decrease in the authentic architectural identity in contemporary architecture in Medina. Many of them selected visual privacy, functional performance, and aesthetic appearance as the most important issues determining their selection of window shading type. However, three major drawbacks of high cost, a large number of Rowshan openings, and a lack of skilled people made it difficult to use the traditional form of Rowshan windows.

One aim of Saudi Vision 2030 is that the country becomes one of the major destinations for international visitors attracted by its cultural heritage. For this, contemporary buildings need to be designed to reflect the local culture using a sustainable approach and strengthen the indoor environment quality for the health and well-being of people. A cultural centre project in Riyadh strengthens its cultural identity through social and natural resources. It reflects the Saudi culture, preserves the environment and natural resources. A well-managed design of cultural buildings is essential to promote culture and heritage to reinforce the sense of regional and national identity, towards a sustainable design approach (Moscatelli, 2022).

The formal and aesthetic approach to the expressiveness of architectural language should be an important aspect of contemporary buildings. The surface, texture, form, representation, and expression should dominate over aesthetic purposes in architecture. Using seven case studies in Riyadh, (Moscatelli, 2023) showed a continuity with the cultural heritage of the Najd architecture through the plasticity and malleability of the wall surfaces, the formal character, and the aesthetic approach.

(Moscatelli, 2024) noted that by integrating traditional Saudi architecture into 3D-printed structures, the country is constructing a path to blend the past and the future harmoniously. Analysis of three international case studies showed that authentic local cultural identity has significantly improved the built environment by aligning with 3D printing. Thus, sustainability and cultural heritage are synthesised, leading to the creation of innovative architectural structures, simultaneously rooted in the territory. This cultural reflection can lead Saudi Arabia to reflect on the importance of its heritage, as it ushers in a new era of sustainable construction, maintaining its vibrant nature for generations to come.

A study by (Alnaim, 2025) showed that Najdi doors reveal identity, tradition, and artistry. They reflect the region's heritage and people's bond with their surroundings. The designs used in these doors, their materials, and symbolic meanings substantially contribute to Saudi Arabia's cultural story. They also stress the importance of preserving these elements as critical links to history.

(Abowardah, 2025) analysed two case studies-Al Bujairi Terrace in Riyadh and Design Space AlUla, AlJadidah Arts District for their morphological geometric language and local heritage vocabularies, among other variables. In the case of Al Bujairi Terrace, the geometric morphological language emphasises a balance in massing and proportion, resulting in an architectural style that is grounded in Najdi tradition while also being suitable for modern urban environments. The formal design of architectural language is characterised by cuboid masonry volumes, drawing inspiration from traditional Najdi architecture as its main identity. The local architectural heritage language of Bujairi Terrace aims to reinterpret traditional Najdi forms and materials within a contemporary framework. Its important features are mud-brick style facades, intricately patterned parapets, and shaded courtyards and alleyways designed to mitigate the harsh climate and encourage pedestrian movement. In the case of AlUla Design Space, it incorporates cultural heritage identity through the integration of geometry and materiality,

producing a space that is both derived from heritage and expressive of contemporary design. The local heritage vocabulary involves the incorporation of two important local heritage vocabularies, the courtyard and the Mashrabiyah.

Based on the analysis of seventeen documents, (Mohamed, 2020) concluded that the works of the past were neither mere traditions nor random occurrences. Rather, they were original creative endeavours, each shaped by specific reasons and emerging as a natural communication in response to the developments and demands of their respective eras. The evolution of architectural heritage requires a form of renewable continuity-one that safeguards cultural constants, while simultaneously integrating heritage into contemporary architectural practice. This process involves not only preserving and understanding the distinctive characteristics of heritage and its language, but also adapting and developing them in ways that align with the requirements of the present.

A comparison of King Fahd International Stadium (KFIS) in Riyadh and King Abdullah Sports City Stadium (KASCS) in Jeddah by (Alzahrani, 2022) showed that KFIS was better in architectural identity based on design concept, shape and form, construction technology, the materials used, and relationship with the surroundings. These five components describe how the architect expresses his design ideas in a sustainable manner, matching customer needs.

Sustainable Product Design: Principles and Frameworks

(Chen, 2024) introduced a methodological framework to systematically shape sustainable product strategy. The framework incorporated crucial technologies like a Sustainable Product Strategies Focus Group (SPSFG), Brainstorming, Weighted Decision Matrix (WDM), and Genetic Algorithm (GA). The authors demonstrated their practical application through an example of 3C products. The framework also contributed theoretically by proposing a tool for creating sustainable product strategies that integrates management principles, providing a practical guide for the development of control systems and tools. This study also mapped out implications for the future of sustainable 3C products. A hybrid approach was used for the development of optimal sustainable product strategies across various sectors. The diverse methodologies helped to create a robust framework addressing unique challenges in health systems, education, environment, industry, agriculture, energy, and resource management. The use of multiple methods demonstrated the interdependencies within these sectors. For long-term environmental, social, and economic benefits, it is necessary to integrate data-driven insights and qualitative considerations to facilitate sustainable strategies, optimising resource utilisation. The proposed framework is presented in Figure 1.

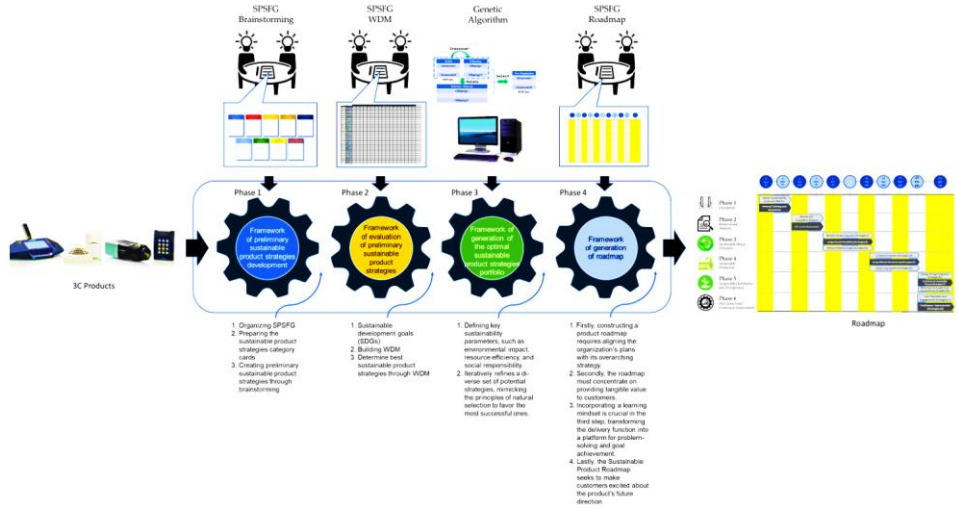

Figure 1 *Framework of hybrid method derived from SPSFG, Brainstorming, WDM, and GA Technologies for creating sustainable product strategies (Chen, 2024).*

A literature review by (Mengistu, Dieste, Panizzolo, & Biazzo, 2024) identified 297 factors affecting sustainable product design (SPD). The most frequently considered factors for SPD were quality and reliability, manufacturability, costs, and financial gain under the economic aspect; resources, waste and emissions, and end-of-life (EOL) management under the environmental aspect; and functionality and usability, and social well-being under the social aspect. These factors were mapped across the total product life-cycle (TPLC) stages. Based on the mapping results, a conceptual framework (Figure 2) was prepared for a comprehensive understanding of these factors and their impact on SPD. In Figure 2, the abbreviations S, M, P, U and PU indicate the TPLC stages of Supply (S), Manufacturing (M), Use (U) and post-use (PU).

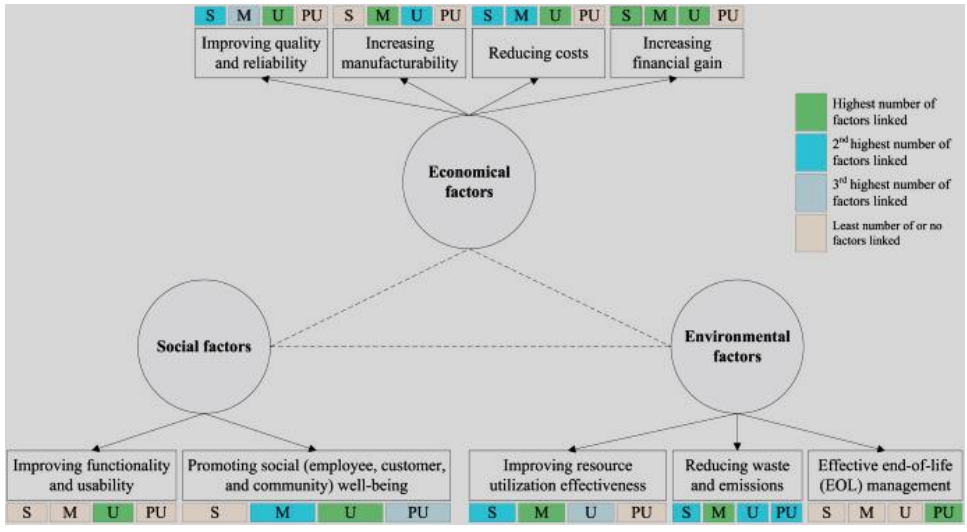

Figure 2 *A conceptual framework for SPD (Mengistu, Dieste, Panizzolo, & Biazzo, 2024).*

(Kim, et al., 2011) integrated product, manufacturing process, and supply chain models to optimise product design variants in terms of costs and environmental impacts. Integrated sustainable design and manufacturing requires multidisciplinary knowledge from various industrial domains to design and manufacture environmentally-responsible products. Sustainable design should consider life cycle costs and environmental impacts, including those related to materials and energy requirements during the manufacturing, use, and end-of-life phases of a product's life. Based on these aspects, the authors constructed an overall architecture of a sustainable product Collaboratory (Figure 3). The framework will deliver a cyber-based tool and interactive e-learning platform. It will educate users in sustainable design and manufacturing by demonstrating the effects of different product designs on supply chain costs and environmental impacts. It is expected to create an evolving design repository, promote empirical/experimental investigation to model life cycle costs and environmental performance, and advance methods for design variants and supply chain optimisation, while being readily available and reusable across a spectrum of learners. It promises a holistic experience facilitated by knowledge sets of product architecture and environmental performance to undertake sustainable design and manufacturing. However, the framework is still under development and has not been validated yet.

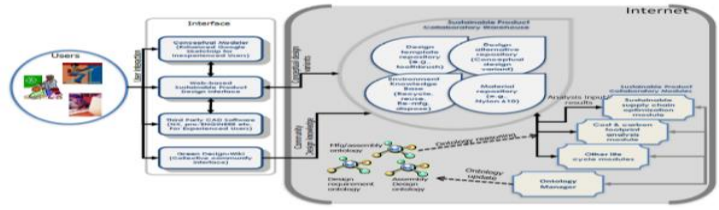

Figure 3 *An overall architecture of a sustainable product Collaboratory (Kim, et al., 2011).*

An axiomatic framework for decisions at every stage of the life cycle was proposed by (Beng & Omar, 2014). The framework has three components: manufacturing considerations, supply chain modelling and end-of-life management, finally leading to sustainable product realisation. The authors provided many examples of its working.

(Chandrakumar, Kulatunga, & Mathavan, 2017) proposed a multi-criteria decision-making model based on the Design for Sustainability (DfS) principles, including an exhaustive set of criteria on social sustainability for evaluating three selected sanitation system designs. The authors used the Fuzzy Analytic Hierarchy Process (FAHP) to solve the model, and a sensitivity analysis to understand the effects of the chosen priority weightings. The analysis showed that the sanitation systems were strongly influenced by the decision to choose either the packaging and logistics phase or the usage phase. This stressed the need for a full life-cycle assessment.

(Fernandes & Junior, 2014) developed a conceptual model for Method Integrated Product Development aimed at sustainability. The method aimed to assist designers in the development process, generating design alternatives directed at sustainable development and the full life cycle of the product. The model was validated using a case study. The model complemented the traditional product design requirements in the current product development models.

(Mestre & Cooper, 2017) introduced a conceptual model for circular product design, which is founded on four strategies involving multiple loops: (I) designing to extend the loops, (II) designing to close the loops, (III) designing inspired by biological processes, and (IV) designing for materials derived from biological sources. They examined recent literature, particularly

related to life cycle design strategies, the conceptual framework of the circular economy, and the European Commission's Circular Economy Package, and analysed product design examples that exemplify each of the proposed strategies. The authors contend that various 'circular' methods focused on different phases of life cycle design can offer practical guiding strategies throughout the design process, thereby fostering sustainable design solutions aligned with the circular economy and the United Nations' sustainable development goals. Their model is presented in Figure 4.

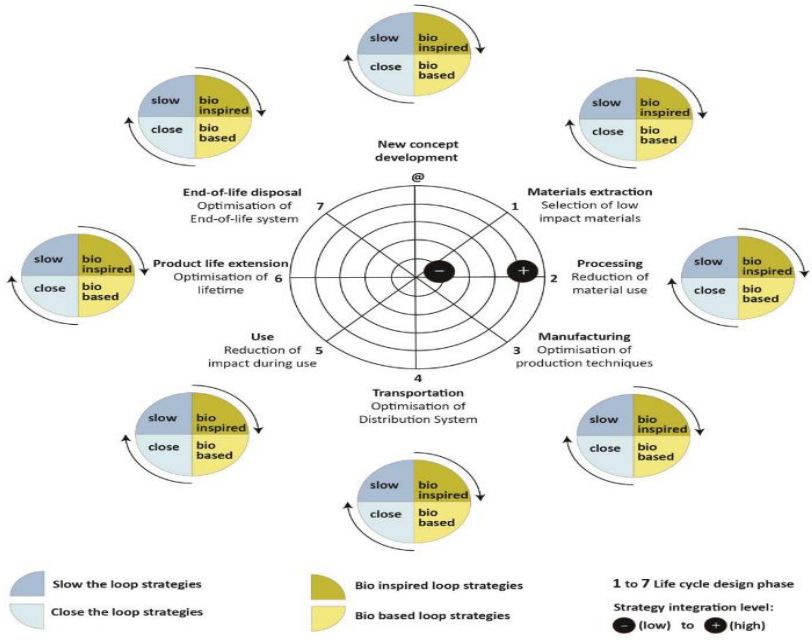

Figure 4 *Multiple loops life cycle design (Mestre & Cooper, 2017).*

Additive manufacturing technology is one method to ensure sustainable product design. It permits designers a lot of freedom to design with mass-customisation of consumer goods. Thus, it has the potential for creating such lasting objects of desire, pleasure, and attachment. Additive manufacturing is currently being used in high-value medical products like hearing aids, medical implants, and the aviation, automotive and marine industries. Current manufacturing tools need to be adapted for practising additive manufacturing. As the technology progresses, new tools will become available for sustainable product design using additive manufacturing methods (Diegel, Singamneni, Reay, & Withell, 2010).

(Haanstra, Martinetti, Braaksma, & van Dongen, 2020) developed a framework for integrating sustainable design principles and sustainability-focused requirements in train modernisation. Tests using this framework showed three key design mechanisms for sustainable modernisation frameworks. They included consideration of sustainability at an early stage, the requirement for simplification to consider sustainability and its impact, and process facilitation by providing resources and requirements.

A review by (Asyraf, et al., 2022) showed that sustainability design incorporates economic, ecological and social aspects. Now, sustainability design is being applied in many concurrent engineering studies related to natural fibre-reinforced polymer composites by professional

designers. On the other hand, research could not bridge the design for sustainability concept with concurrent engineering during the design development stage.

Cultural Motifs in Contemporary Design Practice

(Xiaoju, 2023) noted that Chinese culture has its traditional patterns as an important part. These patterns are immensely related to its history, culture, folklore, religion and other aspects. Traditional patterns have aesthetic, cultural, historical, folklore and other values. Presently, the innovation of traditional motifs in cultural and creative products is a form of artistic expression. The authors elaborated on the connotations and cultural characteristics of traditional motifs, analysed the significance of traditional motif symbols for innovative cultural and creative product design, and clarified the principles for applying traditional motifs in cultural and creative product design.

In today's interconnected era, the interplay between global connectivity and local identity has ignited a powerful resurgence in the visual arts. Cultural motifs and regional nuances, far from fading, have demonstrated remarkable resilience, fuelling a renaissance of creative expression. These elements not only endure across generations but also catalyse new waves of artistic innovation. Contemporary artists are delving into the subtleties of local traditions, weaving them together with advanced media strategies to reinvigorate classical aesthetics, deepen audience engagement, and enhance the transmission of knowledge. For such visionaries, cultural sensitivity is paramount: they must avoid superficial portrayals and misappropriated symbols to ensure the authentic communication of core values. As technology and cultural dynamics grow increasingly intertwined, graphic design is poised to assume an even more pivotal role-safeguarding heritage while simultaneously advancing cultural legacies, and providing fresh pathways for creative evolution (Xiong, 2024).

(Barranco & Song, 2025) noted that traditional culture influences modern fashion design through intangible, behavioural and tangible interconnected dimensions in the spatial aspect of culture. A mixed-method study revealed that fashion operates as a living cultural system, where tradition is continuously reinterpreted in light of contemporary values, social behaviours, and environmental challenges. At the intangible level, emotions, symbols, and narratives embody cultural meaning, preserving heritage while enabling renewal. The behavioural dimension reflects identity, lifestyle, craftsmanship, and modes of use, underscoring fashion's capacity to bridge heritage and innovation, translate traditional languages into modern communicative forms, and advance sustainable practices. Tangible elements such as colour, silhouette, textiles, and ornamentation convey cultural significance, foster sustainability, and inspire artistic experimentation. Across all levels, sustainability emerges as a transversal principle, shaping ethical, aesthetic, and functional choices, and reinforcing fashion's role as both a custodian of heritage and a driver of creative evolution.

Although culture impacts the modern design of products, globalisation and socio-economic dynamics lead to the fading away of this influence. Since culture influences design aesthetics, colours, patterns, symbols, and user expectations, an awareness and sensitivity to current design is required. This will help to promote cross-cultural communication and the development of products that enrich the lives of users from different cultural backgrounds (Mokal, et al., 2025).

(Murtopo, 2024) used multiple methods to study the intersection of cultural ornament motifs, design principles, and Islamic values. The results showed that cultural motifs enhance the aesthetic value of design and also serve as a medium for reflecting Islamic values. The examples

include Tawhid (the oneness of God) and Ihsan (excellence). Thus, creating innovative works can honour both tradition and religion.

(Sharma, Jeet Singh, & Rose, 2016) developed 20 traditional motifs and used CAD to develop contemporary forms and designs from them. The best five were transferred to 15 saris using appliqué in selected placements for each design and simulation in a selected colourway. Fifteen appliqué saris were embellished with hand, machine and digital embroidery. The developed motifs were ranked.

(Chunting, Waijittragum, Mayusoh, & Puntien, 2025) examined representative Yi motifs, focusing on their cultural significance and potential adaptability to contemporary cultural souvenir products. Field documentation of Yi patterns in clothing, textiles, and artefacts was combined with a literature review and expert interviews. Findings reveal that Yi motifs function as cultural narratives, ranging from totemic animal symbols (such as the tiger) to cosmic elements and geometric designs, each reflecting aspects of Yi identity, belief systems, and aesthetic values. Expert validation further indicates that many of these motifs can be creatively incorporated into product design while preserving their symbolic integrity. However, authenticity requires careful attention to scale, colour, and contextual application.

(Wesnina, Prabawati, & Noerharyono, 2025) examined how traditional Indonesian batik motifs can be integrated with contemporary designs through digital techniques, while maintaining their cultural integrity. Using qualitative methods, the authors showed that thoughtful integration of digital techniques with traditional Indonesian batik offers a promising pathway for the evolution of this art form, enabling innovation while safeguarding its cultural heritage. This balanced approach ensures that the batik industry remains relevant in a rapidly changing world without compromising its rich cultural roots. The study further emphasises the importance of sustainable practices and collaborative engagement among traditional artisans, designers, and cultural historians to support this transformation. Based on the findings, the authors proposed a framework to create innovative batik designs by combining traditional and digital methods, involving stages of inspiration, concept development, design execution, and finalisation.

Orang Ulu's material culture flourishes through the development of motif design and presents the first Orang Ulu woven fabric in a 3D graphical view. Motif design is a beautiful way to preserve and promote the rich cultural identity of Orang Ulu through graphical expression. It also has the potential to boost the local economy by providing employment opportunities for skilled artisans. Using mixed methods, (Jalil, Abdullah, Wong, Hoon, & Amaran, 2024) highlighted the exciting potential for SMEs to preserve and promote the Orang Ulu cultural heritage and sustainability while providing economic benefits for the community.

Chinese totems consist of a diverse range of elements, including dragons, phoenixes, tigers, snakes, bears, peaks, crows, wild boars, fish, wolves, cows, eagles, mountains, sheep, monkeys, birds, Teak, banyan, bamboo, gourds, and boats. Some of these elements are significant as totems of specific ethnic minority areas within China. However, their international recognition and representation as Chinese totems have been limited due to their smaller population and lesser influence. The dragon and phoenix are the most widely recognised as representative Chinese totems. (Gao & Yezhova, 2023) used multiple methods to show that all widely used traditional Chinese patterns are not totems. Totems are patterns with more symbolic meaning. The cultural implications of Chinese-style patterns widely used in modern clothing design are widely known, with their innovative methods and patterns.

The Saudi Context: Vision 2030, Heritage, and Modernity

The study by (Ebrahim, 2025) examined the tensions between modernisation, cultural preservation, and sustainability in Al-Balad and the Jeddah Corniche by evaluating the socio-economic and environmental impacts of Jeddah's re-urbanisation under Saudi Vision 2030. A mixed-methods approach was employed. Findings indicate that low-cost housing was not a statistically significant predictor of resident satisfaction, whereas cultural preservation, green infrastructure, and community participation were positively associated. The risks of gentrification were underscored by a composite equity index revealing disparities in income and housing affordability. These results affirm that historic revitalisation and sustainable practices can be integrated to enhance social equity and economic diversification. Strategic priorities include restoring Al-Balad's heritage structures, expanding green spaces, and advancing participatory planning to mitigate displacement. Aligned with Vision 2030's objectives of resilience, inclusion, and cultural identity preservation, this study positions Jeddah as a regional exemplar in harmonising innovation with tradition.

Based on descriptive and qualitative approaches, (Hidayat, Machmudi, & Soekarba, 2022) showed that the implementation of Vision 2030 has led to considerable changes over time. Conservative societies quickly implemented the economic and social reforms, leading to a liberal system. Royal power and the assurance of state welfare contributed to these changes.

(Mazzetto & Vanin, 2023) analysed four cases of sustainable reuse by adopting sustainability criteria and principles in compliance with Saudi Vision 2030, which targets sustainable growth in the post-oil era. Results showed the adoption of different approaches by different institutions in conserving heritage values to provide flexibility for the reuse of buildings and adapt to contemporary needs.

Saudi Arabia's Islamic heritage and cultural traditions have profoundly shaped the nation's craft sector. To safeguard this historical treasure, the government has advanced Vision 2030, a comprehensive initiative designed to revitalise and reintroduce local crafts and arts in alignment with national values and traditions. Handicrafts not only preserve the country's social roots and cultural identity but also contribute significantly to economic development. They generate employment, enhance family incomes, and attract tourists who value handmade expressions crafted from diverse materials. As a cornerstone of Saudi heritage, handicrafts embody the community's identity-bridging past, present, and future. Recognising their importance, the government has prioritised the revival of cultural crafts as a pathway to national growth and success. Central to this effort is the establishment of craft centres within historic sites, reinforcing the connection between heritage and modern development. In addition, the National Project of Professional Heritage Management has been launched to authenticate and preserve traditional professions and handicrafts. Through these initiatives, Saudi Arabia seeks not only to restore its cultural identity but also to position its craft sector as a driver of sustainable economic and social progress (Mohamed & Al-Shammari, 2024).

(Al Zahrani, 2026) explored how art, once regarded primarily as a luxury commodity, is being repositioned as a central driver of societal advancement in metropolitan hubs such as Riyadh, Abu Dhabi, Doha, and Dubai. Drawing on art appreciation community theory, the analysis argues that the value of art emerges through a dynamic interplay among institutions, critics, and the public-together constituting an "art world." Crucially, the research highlights the role of state-led initiatives, particularly those aligned with Saudi Vision 2030, in deliberately cultivating this

ecosystem. By establishing museums, launching public art programs, and promoting creative education, governments across the Gulf are reshaping the cultural landscape. As a result, the region's art scene is undergoing rapid transformation, with art now positioned not only as a catalyst for socioeconomic development but also as a vital medium for articulating and reinforcing national identity.

Heritage-based urban regeneration has emerged as a vital strategy for preserving cultural identity while advancing sustainable urban development. This study focuses on Tarout Island-one of Saudi Arabia's oldest continuously inhabited sites-which faces pressing challenges of urbanisation, infrastructure decline, and heritage conservation. Within the framework of Vision 2030, regeneration efforts must carefully balance modernisation while safeguarding historical and cultural assets to sustain the island's distinctive identity. (Aldossary, Alqahtany, & Alshammari, 2025) used global, regional, and local case studies to identify the best practices in heritage-driven renewal, including adaptive reuse, sustainable tourism, community engagement, infrastructure integration, and environmental stewardship. The findings highlight the need for a comprehensive regeneration framework that not only protects historical sites but also stimulates economic growth, reinforces cultural continuity, and empowers local communities. The study advances a strategic framework for Tarout Island's regeneration, integrating conservation policies, sustainable tourism models, and participatory planning approaches. It also addresses critical challenges such as weak legal enforcement, funding limitations, and the risks of over-commercialisation, emphasising the importance of governance mechanisms that ensure both cultural preservation and long-term sustainability.

Many experiences, solutions, and values are developed as part of Saudi heritage as people deal with the environment over a long time, and they have been passed down to the next generations. These consist of materials, architecture and urban heritage. Based on many observations, (Ghazala, 2021) concluded that it was possible to achieve Saudi identity by specifying the visual scope of some new buildings using vocabulary and heritage values. In this respect, the concept of a service circle in the planning of neighbourhoods can be applied. The sustainability of the urban heritage vocabulary was characterised by identity, which led to a reduction in alienation in Saudi urbanism during the current century.

The role of the Saudi Heritage Commission is to preserve and promote the country's heritage and culture both locally and internationally. An examination of the strategies used by the Commission to play its role led (Almakaty, 2025) to the finding that the Commission uses multiple approaches to improve global awareness of Saudi culture. It also promotes cultural pride and economic benefits. However, there are challenges of resource allocation and authentic representation that persist. It highlights the need for continuous evaluation and adaptation.

A study using multiple methods by (Alqahtany & Aravindakshan, 2022) showed a substantial trade-off between heritage site conservation, population and economic demand for increased urbanisation. Thus, increasing urbanisation pressures may necessitate a reconsideration of the value of the heritage site based on Saudi Arabia's economic and cultural conservation perspectives.

In Saudi Arabia, different tangible and intangible cultural heritage sites and assets have been protected to support and improve the new national tourism ideas through heritage conservation projects and initiatives by governmental and nongovernmental organisations. The study by (Sampieri & Bagader, 2024) showed significant changes in Jeddah city due to its opening to tourism with the associated opportunities and risks.

Under Vision 2030, the heritage of Saudi Arabia, along with its Arab and Islamic traditions,

which are products of an ancient civilisation and deeply embedded in the nation's history, is currently being celebrated to reinforce the national identity of local Arab values. The country aims to preserve heritage sites and the local environment by promoting tourism and hospitality services. The government has been implementing many initiatives and promoting many urban planning processes, programmes, and projects to increase the tourist offer. These steps are aimed towards a sustainable approach for the healthy growth of the country, especially its cities (Mazzetto, 2022).

METHODOLOGY

Research Design and Philosophical Stance

This study adopts a sequential explanatory mixed-methods design grounded in a pragmatist epistemology. The research was conducted in two successive phases: a quantitative survey phase followed by a qualitative interview phase. The rationale for this design lies in the multidimensional nature of the research problem, which requires both statistical generalisability and contextual depth. Cultural motif integration into sustainable product design involves measurable attitudes and perceptions alongside nuanced, experience-based knowledge that can only be captured through in-depth dialogue. The pragmatist stance permits the researcher to draw on both positivist and interpretivist traditions, selecting methods based on their capacity to answer the specific research questions rather than adhering to a single paradigm.
Phase One comprised a structured questionnaire distributed across the five major administrative regions of Saudi Arabia. Phase Two involved semi-structured expert interviews conducted face-to-face in Riyadh and Jeddah, with remote sessions via Zoom for participants in Asir and the Eastern Province. By sequencing the quantitative data collection before the qualitative inquiry, initial statistical patterns informed the development of targeted interview protocols, ensuring that the qualitative phase explored the mechanisms behind the trends observed in the survey data.

Study Context and Ethical Considerations

The research was situated within the Kingdom of Saudi Arabia, a context that is undergoing rapid modernisation under the Saudi Vision 2030 programme while simultaneously emphasising the preservation and revitalisation of its built heritage. Ethical approval was obtained from the Institutional Review Board (IRB) of Umm Al-Qura University before any data collection. Informed consent forms were prepared in both Arabic and English and presented to every participant. Given the cultural context of Saudi Arabia, several additional ethical safeguards were adopted: gender-separated focus-group arrangements were offered where appropriate; all interview transcripts were anonymised using alphanumeric codes (e.g., EXP-01 through EXP-18); and data were stored on encrypted, locally hosted servers in compliance with the Saudi Personal Data Protection Law (PDPL) enacted in September 2023.

Population and Sampling

Quantitative Phase: Survey Sampling

The target population comprised Saudi nationals and long-term residents aged 18 and above with a demonstrated interest in or professional connection to architecture, product design, cultural

heritage, or sustainability. A multi-stage stratified random sampling strategy was employed. In the first stage, the Kingdom was divided into five strata corresponding to its principal regions: Riyadh, Jeddah/Makkah, the Eastern Province, Asir/Southern Regions, and all other provinces. In the second stage, within each stratum, a quota proportional to regional population shares was applied to ensure representative coverage.

A minimum sample size of 384 was calculated using Cochran's formula at a 95% confidence level with a 5% margin of error. Anticipating a 15–20% non-response rate, 480 questionnaires were distributed. After data cleaning, removing incomplete responses (more than 10% missing values) and failed attention-check items, the final analytic sample comprised 384 valid responses. The demographic characteristics of the sample are presented in Table 1.

Table 1 Demographic Profile of Survey Respondents (n = 384)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	198	51.6
	Female	186	48.4
Age Group	18–25	67	17.4
	26–35	112	29.2
	36–45	98	25.5
	46–55	72	18.8
	56+	35	9.1
Region	Riyadh	134	34.9
	Jeddah / Makkah	97	25.3
	Eastern Province	82	21.4
	Asir / Southern Regions	42	10.9
	Other	29	7.6
Professional Background	Architect / Urban Planner	89	23.2
	Product / Industrial Designer	76	19.8
	Cultural Heritage Specialist	54	14.1
	Academic / Researcher	62	16.1
	General Consumer	103	26.8

Qualitative Phase: Expert Sampling

For the qualitative phase, purposive expert sampling was used to recruit 18 participants with specialised knowledge in at least one of the following domains: Saudi architectural heritage, sustainable product design, industrial design, or cultural policy. Recruitment was conducted through formal letters sent to professional bodies, including the Saudi Council of Engineers, the Saudi Design Council, and the Heritage Commission under the Ministry of Culture. Participants were required to have a minimum of five years of professional or academic experience in their

respective fields. The final panel included six architects specialising in heritage restoration, four product/industrial designers, three sustainability consultants, three cultural heritage scholars, and two urban planners affiliated with Vision 2030 giga-projects.

Data Collection Instruments

Structured Questionnaire

The questionnaire was developed through an iterative process involving item generation from the literature, expert review, and pilot testing. The final instrument contained 33 items distributed across six constructs measured on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The constructs were: Cultural Motif Recognition (CMR), Sustainability Awareness (SA), Design Integration Feasibility (DIF), Consumer Acceptance (CA), Innovation Potential (IP), and Cultural Preservation Attitude (CPA). An additional section gathered demographic data, including gender, age, region of residence, and professional background.

The questionnaire was prepared in Arabic as the primary language and then translated into English using a forward-backwards translation method, verified by two bilingual subject-matter experts. A pilot study was conducted with 40 respondents (excluded from the final analysis) across Riyadh and Jeddah. Pilot results informed minor wording revisions and confirmed satisfactory internal consistency (Cronbach's $\alpha > 0.80$ for all constructs). Distribution was conducted electronically via a secure platform hosted on a Saudi-based server, disseminated through professional networks, university mailing lists, and social media channels popular in the Kingdom (Twitter/X and LinkedIn).

Table 2 Survey Constructs, Reliability, and Convergent Validity Indicators

Construct	Items	Cronbach's α	CR	AVE	Mean
Cultural Motif Recognition (CMR)	6	0.91	0.92	0.66	4.21
Sustainability Awareness (SA)	5	0.88	0.89	0.62	3.97
Design Integration Feasibility (DIF)	7	0.89	0.90	0.58	3.84
Consumer Acceptance (CA)	5	0.93	0.94	0.75	4.08
Innovation Potential (IP)	4	0.86	0.87	0.63	4.15
Cultural Preservation Attitude (CPA)	6	0.90	0.91	0.64	4.32

Semi-Structured Expert Interview Protocol

The interview guide was structured around four thematic domains derived from the survey results: the cultural significance and design potential of specific architectural motifs, the practical feasibility of embedding these motifs into sustainable products, market and consumer dynamics in the Saudi context, and the policy and institutional support mechanisms required for successful Integration. Each interview lasted between 45 and 75 minutes and was audio-recorded with

explicit consent. Interviews conducted in Arabic were transcribed verbatim and then translated into English for analysis. Member-checking was carried out by returning summarised transcripts to participants for validation within two weeks of the interview.

Data Analysis Procedures

Quantitative Analysis

All quantitative data were analysed using IBM SPSS (Version 29) and AMOS (Version 28). Descriptive statistics, including means, standard deviations, frequencies, and percentages, were calculated for all constructs and demographic variables. Construct reliability was assessed via Cronbach's alpha ($\alpha > 0.70$ threshold) and composite reliability ($CR > 0.70$). Convergent validity was evaluated using average variance extracted ($AVE > 0.50$), and discriminant validity was confirmed through the Fornell-Larcker criterion.

Confirmatory factor analysis (CFA) was performed to verify the measurement model, followed by structural equation modelling (SEM) to test hypothesised relationships among constructs. Additionally, a hierarchical multiple regression analysis was conducted to quantify the predictive influence of cultural motif recognition, sustainability awareness, design integration feasibility, innovation potential, and cultural preservation attitude on consumer acceptance of culturally embedded sustainable products. Multicollinearity was assessed through variance inflation factor (VIF) values, with a threshold of $VIF < 5$. Model fit was evaluated against standard benchmarks: $\chi^2/df < 3.0$, $CFI > 0.90$, $TLI > 0.90$, $RMSEA < 0.08$, and $SRMR < 0.08$.

Qualitative Analysis

Interview transcripts were imported into NVivo 14 and analysed using Braun and Clarke's reflexive thematic analysis. The analysis proceeded through six phases: familiarisation with the data, initial code generation, theme searching, theme review, theme definition and naming, and report production. Two independent coders analysed a randomly selected subset of six transcripts (33%) to establish inter-coder reliability, achieving a Cohen's kappa of 0.84, indicating substantial agreement. Discrepancies were resolved through discussion and consensus.

Framework Development Process

The proposed framework for integrating Saudi architectural motifs into sustainable product design was developed through a structured four-stage process. First, a systematic review of existing cultural design and sustainable design frameworks was conducted to identify foundational principles and recurring dimensions. Second, quantitative results from the survey identified the motifs with the highest recognition, sustainability potential, and design adaptability scores. Third, qualitative insights from expert interviews were synthesised with the quantitative findings through a joint display matrix, wherein statistical patterns were paired with explanatory qualitative themes to generate integrative assertions. Fourth, the draft framework was subjected to a modified Delphi validation process involving a sub-panel of 12 experts (drawn from the 18 interviewees) across two iterative rounds, with a 70% consensus threshold required for the retention of each framework dimension.

Rigour and Trustworthiness

Quantitative rigour was established through validated scales, pilot testing, and confirmatory factor analysis. Qualitative trustworthiness was enhanced through prolonged engagement with participants, member-checking, audit trails maintained in NVivo, and triangulation between

survey data and interview narratives. The use of a mixed-methods design itself constitutes a form of methodological triangulation, strengthening the overall credibility of the findings.

RESULTS

This section presents the findings of the study organised by research question and method. Quantitative results are presented first, followed by qualitative findings, and finally, the integrated framework derived from both data streams.

Quantitative Findings

Measurement Model Evaluation

Confirmatory factor analysis demonstrated an acceptable fit of the measurement model to the data: $\chi^2(480) = 876.43$, $\chi^2/df = 1.83$, CFI = 0.94, TLI = 0.93, RMSEA = 0.047, SRMR = 0.041. All standardised factor loadings exceeded the 0.60 threshold, ranging from 0.67 to 0.89. As presented in Table 2, all constructs demonstrated strong internal consistency with Cronbach's alpha values ranging from 0.86 (Innovation Potential) to 0.93 (Consumer Acceptance). Composite reliability values ranged from 0.87 to 0.94, and all AVE values exceeded 0.50, confirming convergent validity. Discriminant validity was established through the Fornell-Larcker criterion, with the square root of each construct's AVE exceeding its inter-construct correlations.

Identification of Key Architectural Motifs

Respondents identified and rated seven principal Saudi architectural motifs that hold the greatest potential for integration into sustainable product design. As shown in Table 3, the Mashrabiyya lattice screen was the most frequently cited motif (92.4%) and received the highest sustainability score (M = 4.67) and design adaptability score (M = 4.72). This was followed by Al-Qatt Al-Asiri geometric wall paintings (87.2% citation frequency), which scored highly on both sustainability (M = 4.41) and design adaptability (M = 4.53). Sadu weaving motifs, rooted in Bedouin material culture, achieved notable sustainability scores (M = 4.48) owing to their association with natural fibres and traditional low-impact production methods.

Table 3 Saudi Architectural Motifs Identified for Sustainable Product Design Integration

Architectural Motif	Regional Origin	Freq. Cited (%)	Sustainability Score (M)	Design Adapt. Score (M)
Al-Qatt Al-Asiri patterns	Asir Region	87.2	4.41	4.53
Mashrabiyya lattice screens	Hejaz (Jeddah)	92.4	4.67	4.72
Najdi geometric façades	Najd (Riyadh / Dir'iyyah)	84.6	4.18	4.29
Rawshan window projections	Hejaz (Makkah / Madinah)	78.9	4.55	4.38
Coral-stone wall textures	Eastern Province (Al-Ahsa)	63.5	4.23	3.87
Muqarnas vault carvings	Various (Mosque architecture)	71.4	3.92	4.11
Sadu weaving motifs	Bedouin / Northern Regions	76.8	4.48	4.61

Structural Model and Hypothesis Testing

The structural equation model demonstrated good fit: $\chi^2(483) = 912.17$, $\chi^2/df = 1.89$, CFI = 0.93, TLI = 0.92, RMSEA = 0.048, SRMR = 0.044. The model explained 61.4% of the variance in Consumer Acceptance ($R^2 = 0.614$). Cultural Motif Recognition emerged as the strongest predictor of Consumer Acceptance ($\beta = 0.34$, $p < .001$), followed by Sustainability Awareness ($\beta = 0.28$, $p < .001$) and Design Integration Feasibility ($\beta = 0.22$, $p < .001$). Innovation Potential ($\beta = 0.19$, $p = .002$) and Cultural Preservation Attitude ($\beta = 0.15$, $p = .003$) also contributed significantly. All VIF values remained below the 5.0 threshold (range: 1.34–1.56), confirming the absence of problematic multicollinearity. Complete regression results are provided in Table 4.

Table 4 Hierarchical Multiple Regression Results: Predictors of Consumer Acceptance (n = 384)

Predictor	β	SE	t	p	VIF	95% CI
Cultural Motif Recognition	0.34	0.05	6.80	<.001	1.42	[0.24, 0.44]
Sustainability Awareness	0.28	0.06	4.67	<.001	1.38	[0.16, 0.40]
Design Integration Feasibility	0.22	0.05	4.40	<.001	1.56	[0.12, 0.32]
Innovation Potential	0.19	0.06	3.17	.002	1.47	[0.07, 0.31]
Cultural Preservation Attitude	0.15	0.05	3.00	.003	1.34	[0.05, 0.25]

Note. $R^2 = 0.614$; Adjusted $R^2 = 0.609$; $F(5, 378) = 120.47$, $p < .001$. Dependent variable: Consumer Acceptance.

Regional and Demographic Variations

One-way ANOVA revealed statistically significant regional differences in Cultural Motif Recognition, $F(4, 379) = 8.23$, $p < .001$, $\eta^2 = 0.08$. Post-hoc Tukey HSD tests indicated that respondents from the Asir/Southern Regions scored significantly higher on CMR ($M = 4.58$, $SD = 0.49$) than those from Riyadh ($M = 4.12$, $SD = 0.61$, $p = .003$) and the Eastern Province ($M = 4.04$, $SD = 0.65$, $p = .001$), likely reflecting the stronger preservation of decorative traditions such as Al-Qatt Al-Asiri in southern communities. An independent-samples t-test showed no significant gender difference in Consumer Acceptance, $t(382) = 1.14$, $p = .256$, $d = 0.12$, suggesting that willingness to adopt culturally embedded sustainable products is comparable across genders.

Age group analysis using Kruskal-Wallis tests revealed a significant effect of age on Sustainability Awareness, $H(4) = 18.72$, $p < .001$. Respondents aged 26–35 scored highest ($M = 4.21$, $SD = 0.53$), while those aged 56 and above scored lowest ($M = 3.56$, $SD = 0.71$). Professional background significantly influenced Design Integration Feasibility scores, $F(4, 379) = 11.47$, $p < .001$, $\eta^2 = 0.11$, with product/industrial designers reporting the highest feasibility perceptions ($M = 4.24$, $SD = 0.48$) compared to general consumers ($M = 3.51$, $SD = 0.72$, $p < .001$).

Qualitative Findings

Thematic Overview

Reflexive thematic analysis of the 18 expert interviews yielded five overarching themes and 15 sub-themes. Table 6 summarises the thematic structure, including the frequency with which each theme appeared across transcripts and a representative insight.

Table 6 Thematic Structure from Expert Interviews (n = 18)

Theme	Sub-themes	Frequency	Representative Insight
Heritage as Design Resource	Pattern reinterpretation; Motif scalability; Regional distinctiveness	14 of 18	Mashrabiyya patterns translate naturally into parametric design surfaces
Sustainability Synergy	Passive cooling principles; Local material sourcing; Lifecycle alignment	12 of 18	Traditional ventilation logic embedded in Rawshan design offers passive-cooling solutions
Market Readiness	Consumer demand; Vision 2030 alignment; Tourism potential	15 of 18	Strong consumer appetite exists under the cultural identity push of Vision 2030
Implementation Barriers	Skill gaps; Cost concerns; Standardisation difficulty	11 of 18	Artisan workforce is shrinking; digital fabrication may bridge the gap
Innovation Pathways	Parametric design; Smart materials; Digital twin prototyping	13 of 18	Generative algorithms can produce infinite culturally grounded pattern variations

Theme 1: Heritage as a Design Resource

Fourteen of the 18 experts emphasised that Saudi architectural motifs represent an underutilised yet highly versatile design resource. Participants noted that motifs such as the Mashrabiyya and Sadu weaving patterns possess inherent geometric regularity that makes them amenable to parametric and computational design tools. One architect specialising in heritage restoration (EXP-03) observed that these patterns contain embedded mathematical relationships-rooted in Islamic geometric principles-that can be algorithmically parameterised to generate infinite scalable variations without compromising cultural authenticity. Several experts highlighted the importance of what they termed "respectful abstraction," wherein the essential visual grammar of a motif is preserved even as it is adapted to new materials and production processes.

Theme 2: Sustainability Synergy

Twelve experts articulated a strong alignment between traditional Saudi architectural principles and contemporary sustainability goals. The Rawshan and Mashrabiyya were repeatedly cited as historical precedents for passive environmental control, specifically natural ventilation, daylighting modulation, and thermal regulation. Sustainability consultants on the panel (EXP-09, EXP-11) argued that re-applying these principles in product-scale applications-such as 3D-

printed shading panels and modular room dividers-represents a direct transfer of culturally embedded sustainability knowledge. Experts also noted that Sadu weaving relies on locally sourced sheep and camel wool, providing a precedent for bio-based and regionally sourced materials in sustainable product lines.

Theme 3: Market Readiness

Market readiness was the most frequently mentioned theme across the expert panel (15 of 18 participants). Experts consistently linked consumer demand for culturally embedded products to the broader national identity discourse promoted under Vision 2030. Cultural heritage scholars noted that the establishment of the Ministry of Culture in 2018, the development of cultural districts such as Diriyah Gate and Jax District, and the growing creative economy sector have created an environment in which heritage-informed design products are viewed not as nostalgic artefacts but as markers of a forward-looking Saudi identity. Product designers on the panel (EXP-05, EXP-07) reported that client briefs increasingly request "Saudi character" in product aesthetics, reflecting a market shift.

Theme 4: Implementation Barriers

Despite the optimistic outlook, 11 experts identified substantive implementation barriers. The most frequently cited challenge was a diminishing pool of artisans with the traditional craft knowledge needed to inform high-fidelity motif reproduction. Experts in both architecture and product design flagged cost concerns associated with the precision manufacturing required for intricate geometric motifs, particularly when small-batch production is involved. Standardisation emerged as a further barrier: unlike mass-market products, culturally specific motifs resist easy codification into universal design standards, complicating supply-chain integration and quality assurance.

Theme 5: Innovation Pathways

Thirteen experts described specific technological and methodological pathways through which the integration of motifs and sustainability could be achieved at scale. Parametric design software such as Grasshopper for Rhino was cited by six architects and designers as a tool capable of generating culturally accurate yet novel pattern variations. Three experts proposed digital twin prototyping as a means of simulating the environmental performance of motif-based product features (e.g., airflow through Mashrabiyya-inspired panels) before physical production. Smart and responsive materials-such as shape-memory polymers and thermochromic coatings-were mentioned by sustainability consultants as emerging technologies that could add functional sustainability value to decorative motif surfaces.

Framework Validation

The proposed framework, titled the Saudi Cultural-Sustainable Product Design (SC-SPD) Framework, was subjected to a modified Delphi validation process with a sub-panel of 12 experts. The framework comprises five interconnected dimensions: Cultural Authenticity Criteria, Sustainability Integration, Design Adaptability Protocol, Market Viability Assessment, and Innovation-Tradition Balance. Content validity was assessed using the Content Validity Index (CVI), inter-rater agreement percentages, and Cohen's kappa. Table 5 presents the validation results.

Table 5 Expert Panel Validation of the SC-SPD Framework (n = 12)

Framework Dimension	CVI	Mean Relevance (1–4)	Agreement (%)	Kappa
Cultural Authenticity Criteria	0.94	3.71	94.1	0.82
Sustainability Integration	0.91	3.65	91.2	0.78
Design Adaptability Protocol	0.88	3.53	88.2	0.75
Market Viability Assessment	0.85	3.41	85.3	0.72
Innovation-Tradition Balance	0.91	3.59	91.2	0.79
Overall Framework	0.90	3.58	90.0	0.77

All five dimensions achieved a CVI above the 0.78 threshold recommended for multi-expert panels. The overall framework CVI was 0.90, with an aggregate inter-rater agreement of 90.0% and a mean kappa of 0.77, indicating substantial agreement. Minor revisions suggested during the Delphi process included the addition of a lifecycle assessment sub-criterion within the Sustainability Integration dimension and a more explicit reference to Saudi Building Code (SBC) compliance within the Design Adaptability Protocol. These modifications were incorporated into the final version of the framework.

Integrated Findings: Joint Display Summary

The integration of quantitative and qualitative findings through a joint display matrix revealed strong convergence between the two data streams. The survey finding that Cultural Motif Recognition was the strongest predictor of Consumer Acceptance ($\beta = 0.34$) was corroborated by the qualitative theme of Heritage as a Design Resource, in which experts explained that consumers respond positively to products that visibly communicate a recognisable Saudi design language. Similarly, the statistically significant influence of Sustainability Awareness on Consumer Acceptance ($\beta = 0.28$) was enriched by the qualitative theme of Sustainability Synergy, wherein experts articulated the specific mechanisms-passive cooling, natural fibre use, local material sourcing-through which traditional motifs embody sustainability.

One area of divergence emerged between the data streams. While the quantitative data showed Innovation Potential as a moderately strong predictor ($\beta = 0.19$), the qualitative interviews revealed that experts consider innovation pathways to be the most critical factor for long-term scalability and commercialisation. This suggests that although consumers currently assign moderate importance to innovation in their acceptance decisions, expert opinion indicates that technological capability will become an increasingly decisive factor as the market matures.

DISCUSSION

Interpretation of Key Findings in Relation to Research Questions

The following table provides the research questions and the findings related to them.

Research Question	Findings
To what extent can cultural motifs predict consumer acceptance?	Cultural Motif Recognition emerged as the strongest predictor of Consumer Acceptance ($\beta = 0.34$, $p < 0.001$)
To what extent can sustainability awareness predict consumer acceptance?	Sustainability Awareness predicted consumer acceptance substantially ($\beta = 0.28$, $p < .001$)
To what extent can design integration feasibility predict consumer acceptance?	Design Integration Feasibility predicted consumer acceptance fairly well ($\beta = 0.22$, $p < .001$)
To what extent can innovation potential predict consumer acceptance?	Innovation Potential predicted consumer acceptance moderately ($\beta = 0.19$, $p = .002$)
To what extent can cultural preservation attitude predict consumer acceptance?	Cultural Preservation Attitude predicted consumer acceptance moderately ($\beta = 0.15$, $p = .003$)
How do regional differences impact cultural motif recognition (CMR)?	Respondents from Asir/Southern Regions scored significantly higher on CMR ($M = 4.58$, $SD = 0.49$) than those from Riyadh ($M = 4.12$, $p = .003$) and Eastern Province ($M = 4.04$, $p = .001$)
How do demographic factors impact consumer acceptance, sustainability awareness, and design integration feasibility?	No significant gender difference in Consumer Acceptance ($t(382) = 1.14$, $p = .256$). Significant age effect on Sustainability Awareness ($H(4) = 18.72$, $p < .001$). Professional background significantly influenced DIF scores ($F(4, 379) = 11.47$, $p < .001$, $\eta^2 = 0.11$)
What are the factors determining market-readiness?	Consumer demand, Vision 2030 alignment, Tourism potential
What are the barriers to implementation?	Skill gaps, Cost concerns, Standardisation difficulty
What innovation pathways can be used?	Parametric design; Smart materials; Digital twin prototyping
What is the extent of acceptability of the framework among experts?	The SC-SPD Framework was accepted by all 12 experts, with minor variations among them on framework dimensions

The findings of this study show a fascinating picture of how Saudi cultural motifs intersect with sustainability and consumer psychology. Out of the seven architectural motifs, three stood out. Mashrabiyya lattice screens dominate both recognition and adaptability. Their dual role-cultural identity marker and functional sustainability (passive cooling, shading)-explains why they topped the list. Al-Qatt Al-Asiri wall paintings resonate strongly in southern regions, reflecting living traditions. Their geometric adaptability makes them versatile in product design. Sadu weaving motifs stand out for sustainability, rooted in natural fibres and low-impact production. This shows how material culture directly translates into eco-friendly design.

Among the predictors of consumer acceptance, Cultural Motif Recognition ($\beta = 0.34$) emerged as the strongest driver. Consumers want products that visibly "speak Saudi," confirming the

qualitative theme of heritage as a design source. Sustainability Awareness (β = 0.28) reinforces that eco-consciousness is not abstract-it's embedded in traditional practices like natural fibre use and passive cooling. Design Integration Feasibility (β = 0.22) highlights the importance of practical adaptability. Designers perceive feasibility more strongly than general consumers, showing a gap between expert and lay perspectives. Innovation Potential (β = 0.19) and Cultural Preservation Attitude (β = 0.15) matter, but innovation is undervalued by consumers compared to experts-suggesting a future shift as markets mature.

Considering the regional differences, Asir respondents score higher on motif recognition, reflecting stronger preservation of Al-Qatt traditions. This underscores the role of living heritage in shaping consumer attitudes.

Among the demographic variables, only age and professional background had significant effects. In the case of age, younger adults (26–35) showed the highest sustainability awareness, while older groups lagged. This generational divide suggests that eco-consciousness is more embedded in younger consumer identities. In the case of professional background, designers saw higher feasibility than general consumers, indicating that expert knowledge enhances confidence in integration. Bridging this perception gap could be key to market readiness. There was no difference in acceptance across genders, suggesting cultural sustainability is a shared value.

Concerning the integrated framework, findings converged into a five-component framework. They were cultural authenticity criteria, sustainability integration, design adaptability protocols, market viability assessment and innovation-tradition balance. All experts agreed on these dimensions with minor variations in the extent of agreement for individual dimensions. Cultural authenticity ensures that motifs are recognisable and meaningful. Sustainability integration leverages traditional eco-friendly practices. Design adaptability protocols translate motifs into scalable product design. Market viability aligns consumer acceptance with expert feasibility. Innovation-tradition balance ensures long-term scalability without eroding heritage.

Overall, the strongest predictor-Cultural Motif Recognition-shows that identity and heritage are the entry points for consumer acceptance. But experts stress innovation pathways as the future driver of scalability. This divergence suggests a two-phase trajectory: Phase 1: Heritage-led adoption (recognition + sustainability), and Phase 2: Innovation-led expansion (scalability + commercialisation).

Theoretical Contributions

The findings of this study yield several theoretical contributions that extend both design theory and cultural sustainability scholarship, in addition to Rogers' Diffusion of Innovations, Hofstede's cultural dimensions, and sustainable design theory.

The findings position cultural recognition as a measurable driver of sustainable product adoption. They reframe sustainability as culturally embedded rather than purely technological. A two-phase innovation trajectory (heritage-led → innovation-led) is introduced. Consumer acceptance models are expanded to regional, generational and professional aspects. The proposed framework is a holistic one, uniting cultural authenticity, ecological design and market viability.

Practical Implications for Designers, Manufacturers and Policymakers

For designers, design adaptability protocols translate cultural motifs into scalable product design. These protocols act as structured frameworks that allow creative teams to move beyond surface-level ornamentation and instead embed cultural meaning into product systems. By codifying

motifs-whether drawn from textiles, architecture, rituals, or visual narratives-into modular design elements, they ensure that cultural specificity can coexist with industrial scalability. Cultural translation occurs when motifs are abstracted into design languages (patterns, palettes, forms) that retain symbolic resonance while being adaptable across contexts. Scalability requires protocols to define how motifs can be resized, recombined, or reinterpreted without losing authenticity, enabling applications across diverse product lines. Interdisciplinary Integration happens when designers collaborate with anthropologists, artisans, and technologists to ensure motifs are not only aesthetically pleasing but also culturally respectful and technically feasible. Market responsiveness depends on adaptability protocols that allow motifs to be localised for different consumer segments, balancing global brand coherence with regional identity. Sustainability needs to be ensured by embedding motifs into scalable frameworks, designers reduce redundancy, encourage reuse of design assets, and foster long-term cultural relevance.

In essence, these protocols transform cultural heritage into a living design system-one that is flexible enough to meet industrial demands yet rooted enough to preserve identity.

For manufacturers, market viability aligns with consumer acceptance. Innovation-tradition balance ensures long-term scalability without eroding heritage. This underscores that production success is not merely about technical feasibility or cost efficiency, but about resonance with consumer values, preferences, and cultural sensibilities. Market viability is achieved when products embody both functional utility and symbolic meaning, ensuring that innovation is welcomed rather than resisted. Consumers accept when products are perceived as authentic, trustworthy, and culturally relevant. Acceptance also hinges on emotional connection as much as on price or performance. In the case of innovation–tradition balance, manufacturers must innovate to remain competitive, but innovation cannot come at the expense of eroding heritage. Instead, tradition provides a stabilising anchor, offering continuity and legitimacy. Long-term scalability depends on harmonising modern production systems with traditional knowledge. This balance allows manufacturers to expand markets without alienating communities or diluting cultural identity. Risk mitigation involves respecting heritage, with manufacturers reducing reputational risks and avoiding consumer backlash that often arises when innovation is perceived as cultural appropriation or disregard. Sustainable growth happens when innovation is aligned with tradition, fostering resilience-products evolve with changing consumer needs while retaining their cultural essence, ensuring longevity in diverse markets. In essence, manufacturers thrive when they treat heritage not as a constraint but as a resource. Tradition provides the narrative, innovation provides the mechanism, and consumer acceptance provides the validation. Together, they form a cycle of sustainable scalability.

For policymakers, there is an opportunity to align policies with the sustainability and culture of the country, both influenced by cultural motifs. Policies must be in place for the correct balance between tradition and modernity, and tradition and economic development. In the case of Saudi Arabia, aligning these policies with Vision 2030 is important. Policy design is not only about economic growth or regulatory efficiency-it is also about embedding cultural identity and ecological responsibility into the nation's development trajectory. Cultural motifs serve as symbolic anchors, guiding how modernity can be harmonised with heritage. To ensure a tradition–modernity balance, policies must safeguard cultural practices while enabling innovation. This requires frameworks that encourage modernisation without displacing traditional knowledge systems. For a tradition–economic development balance, economic growth strategies should integrate heritage industries (crafts, agriculture, cultural tourism) into broader development plans, ensuring that tradition becomes a driver of prosperity rather than a casualty

of progress. Concerning sustainability integration, cultural motifs often embody ecological wisdom-such as water conservation rituals or architectural practices adapted to the climate. Policymakers can translate these motifs into sustainability standards, making culture a resource for resilience. As institutional mechanisms, policies should establish platforms for dialogue between communities, industries, and government, ensuring that cultural voices inform development decisions. For global positioning, cultural heritage should be aligned with sustainability, and countries can differentiate themselves in global markets, projecting soft power and attracting investment in heritage-linked industries.

In the case of Saudi Arabia, aligning these policies with Vision 2030 is important. Vision 2030 emphasises diversification, sustainability, and cultural revitalisation. Policymakers can embed cultural motifs into tourism and creative industries, strengthening national identity while expanding economic opportunities. They can also use tradition-informed sustainability practices (e.g., water management rooted in desert heritage) to meet ecological goals. They need to ensure that modernisation initiatives-digital transformation, industrial diversification-are framed in ways that respect and amplify cultural heritage. In positioning Saudi culture as a global brand, balancing economic competitiveness with cultural authenticity is necessary.

Alignment with Saudi Vision 2030

The strong predictive power of motif recognition confirms Vision 2030's emphasis on cultural identity. Products that visibly communicate Saudi motifs (e.g., Mashrabiyya, Al-Qatt Al-Asiri, Sadu weaving) strengthen national pride and global cultural branding. It is related to the Vision 2030 pillar-Vibrant Society-preserving and promoting Saudi heritage. It implies a policy to support creative industries that embed motifs into product design, ensuring cultural visibility in global markets.

Traditional motifs embody sustainability (passive cooling in Mashrabiyya, natural fibres in Sadu weaving). Consumer acceptance rises when heritage is linked to ecological responsibility. This is linked to the Vision 2030 pillar: Thriving Economy-sustainable resource use and ecological resilience. Policymakers can incentivise manufacturers to adopt heritage-informed sustainability practices, aligning with Vision 2030's environmental goals.

In the case of design integration feasibility, product/industrial designers scored highest on feasibility perceptions, showing professional readiness to integrate motifs into scalable production. This aligns with Vision 2030 pillar: Ambitious Nation-fostering innovation and industrial diversification. Policies are required to promote investment in design education and R&D hubs that merge tradition with advanced manufacturing, supporting Vision 2030's diversification agenda.

While consumers currently assign moderate importance, experts highlight innovation pathways as critical for scalability. This reflects Vision 2030's call for technological capability to underpin cultural industries. This is linked to Vision 2030 pillar: Thriving Economy-innovation as a driver of competitiveness. Policies to develop innovation incubators can promote innovation.

Consumers accept products when they respect heritage. Regional differences (e.g., higher CMR in Asir due to Al-Qatt Al-Asiri traditions) highlight the importance of localised cultural preservation. This is related to Vision 2030 pillar: Vibrant Society-safeguarding traditions while modernising. Regional cultural policies should be tailored to preserve distinctive traditions, feeding into Vision 2030's tourism and heritage revitalisation strategies.

Stronger motif recognition in Asir reflects Vision 2030's emphasis on regional heritage tourism (e.g., Al-Qatt Al-Asiri as UNESCO-recognised heritage). Higher sustainability awareness among

younger cohorts (26–35) aligns with Vision 2030's youth-centric innovation agenda. Designers' higher feasibility scores support Vision 2030's investment in creative industries and design education. Absence of gender differences in consumer acceptance aligns with Vision 2030's commitment to inclusivity and equal participation.

Alignment of framework dimensions: Cultural Authenticity Criteria reinforce national identity (Vibrant Society). Sustainability Integration advances ecological responsibility (Thriving Economy). Design Adaptability Protocols enable industrial scalability (Ambitious Nation). Market Viability Assessment ensures consumer acceptance and global competitiveness. Innovation–Tradition Balance harmonises modernisation with heritage preservation.

Together, these findings create a Vision 2030 Cultural Motifs Framework: Pillar 1: Vibrant Society → Cultural authenticity and preservation. Pillar 2: Thriving Economy → Sustainable, innovative heritage industries. Pillar 3: Ambitious Nation → Scalable design integration and global competitiveness.

Limitations of This Study

Response bias is possible in the case of the survey. The sample size for interviews (12) may not be adequate to ensure response saturation. By not sending the interview questions in advance to the experts, the possibility of evidence-backed responses might have decreased, although member-checking of responses might have reduced this problem. Only five predictors of consumer acceptance were chosen. More predictors were possible. The proposed framework consisted of only five dimensions. More dimensions could have been extracted from the literature. Empirical validation of the framework was not done. Expert validation might be inadequate.

CONCLUSION AND RECOMMENDATIONS

Summary of Key Findings

The study identified Mashrabiyya lattice screen as the most cited, with the highest sustainability and design adaptability, Al-Qatt Al-Asiri geometric wall paintings with many citations, strong sustainability and adaptability (M = 4.53), and Sadu weaving motifs with notable sustainability linked to natural fibres and low-impact production as the most important motifs.

The predictive model explained about 64% variation in consumer acceptance. The predictors were cultural motif recognition, sustainability awareness, design integration feasibility, innovation potential, and cultural preservation attitude in their decreasing order of strength. The formula explaining this is: Consumer Acceptance = 0.34 CMR + 0.28 SA + 0.22 DIF + 0.19 IP + 0.15 CPA.

Regional differences placed Asir/Southern respondents scored higher on cultural motif recognition than Riyadh and Eastern Province.

While gender did not affect consumer acceptance, age and professional background were significantly related to sustainability awareness and feasibility, respectively.

The qualitative part of the study identified five themes, including heritage as a design source, sustainability strategy, market readiness, implementation barriers, and innovation pathways.

The proposed framework consisted of five dimensions: cultural authenticity criteria, sustainability integration, design adaptability protocols, market viability assessment, and

innovation-tradition balance.

Overall, consumer acceptance of sustainable product design in Saudi Arabia is most strongly driven by recognition of cultural motifs and sustainability awareness, with regional heritage traditions (e.g., Al-Qatt Al-Asiri) playing a key role. While consumers currently prioritise cultural visibility and ecological responsibility, experts emphasise that innovation capacity will be decisive for future scalability-aligning directly with Saudi Vision 2030's goals of cultural preservation, sustainability, and industrial diversification.

6.2 Recommendations for Designers, Industry Stakeholders and Saudi Cultural Institutions

Designers should treat heritage as both a creative source and a sustainability strategy, while building innovation pathways for scalability. By embedding motifs into adaptable design systems and aligning with Vision 2030's pillars, designers can ensure products are culturally authentic, ecologically responsible, and globally competitive.

Industry stakeholders should treat Saudi architectural motifs not as static heritage but as dynamic design resources. By embedding them into sustainable product lifecycles, they can simultaneously preserve culture, drive innovation, and meet Vision 2030's sustainability and identity goals.

Saudi cultural institutions should act as custodians and catalysts-preserving motifs, educating society, fostering innovation, and aligning heritage with Vision 2030. By doing so, they ensure that Saudi identity thrives in modern, sustainable product ecosystems while gaining global recognition.

Policy Recommendations

Policy should act as the bridge-preserving motifs, embedding them into sustainable innovation, and positioning Saudi Arabia as a global leader in cultural-sustainable product design. This requires coordinated action across culture, industry, education, and tourism sectors.

Directions for Future Research

Future research should broaden the scope from symbolic preservation to systematic integration of motifs into sustainable product ecosystems, combining consumer insights, technological innovation, and policy frameworks. This will ensure Saudi heritage thrives as a living, evolving resource in global sustainability narratives.

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