

## The Modular Design for the Creation of Ceramic Products to Revitalize the Local Industry

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**Abstract:** This study investigates the incorporation of modular design concepts to rejuvenate the ceramic sector in Saudi Arabia, with a particular focus on cultural, economic, and philosophical aspects. The study offers a thorough examination by employing an interdisciplinary method that combines design theory, cultural philosophy, and industry development. By conducting comprehensive literature studies and participant questionnaires, this study assesses user satisfaction and investigates the impact of standard design, cultural importance, and philosophical factors in the ceramic sector. This study utilises a combination of descriptive and analytical research methodologies to evaluate proposed designs. The assessment is conducted through the administration of two questionnaires, one including 35 participants and the other comprising 20 professionals. The findings indicate that consumers in Saudi Arabia have a preference for colours that are consistent and designs that are unique, with a particular emphasis on regional relevance. The research highlights both the potential benefits of modular design and the important knowledge it offers to designers. It emphasises the crucial role of local ceramic industries in promoting cultural continuity and improving marketing tactics.

**Keywords:** Ceramic Products, Cultural Philosophy, Innovation, Modular Design, Product Design, Regional Development.

### 1. INTRODUCTION

The Kingdom of Saudi Arabia, renowned for its abundant natural riches, stands prominently as one of the most affluent nations in the world (Al Ghamdi 2020). The Kingdom of Saudi Arabia possesses an estimated total value of natural resources surpassing \$34 trillion and a strong gross domestic product (GDP) of around \$795 billion (Ministry of Economy & Planning 2022). These abundant raw materials make it favourable for ceramic

manufacturing according to the Vision 2020-2030 Kingdom of Saudi Arabia. Although there is a huge amount of these resources available, their complete potential has not been fully utilised yet (Ministry of Economy & Planning 2022), which presents an attractive opportunity for both producers and researchers (Ministry of Education 2020).

This study aims to stimulate the expansion of the ceramic product manufacturing industry in the Kingdom of Saudi Arabia (Hayat and Tahir 2021). Our goal is to enhance the competitiveness of the local ceramic sector by thoroughly examining modular design concepts and introducing novel product designs. The deliberate utilisation of resources that are readily accessible in the local area is expected to lead to a decrease in the costs associated with production, the advancement of ceramic products that are native to the region, and the generation of fresh employment prospects. Consequently, this will encourage greater investment within the Kingdom (Ministry of Economy & Planning 2022).

In addition to the economic aspects, our research seeks to explore the fundamental cultural and philosophical consequences of modular design in the field of ceramic product development. Through the adoption of innovative design approaches, we want to improve the performance and enhance the aesthetic and cultural value of Saudi ceramic products. Our goal is to increase the demand for these products both within Saudi Arabia and internationally (Arab News 2022). Our main objective is to promote and distribute Saudi ceramic products, which will open up new opportunities for employment in the country and strengthen local businesses, making them more competitive.

This thesis explores the cultural and philosophical aspects of using modular design to create ceramic items in the Kingdom of Saudi Arabia (Ministry of Education 2020). The purpose of this investigation is to strengthen local industries and enable them to engage in fierce competition on a global scale (Sun *et al.* 2021). Saudi Arabia's strategic adoption of modular design concepts and cultural exploration is expected to revolutionise the ceramic industry, establishing the country as a prominent global participant.

### 1.1. Background of the Research

Manufacturers worldwide are increasingly adopting modular design as a way to quickly modify existing products or create new ones that are customised to meet individual client preferences or market demands (Panarotto, Isaksson and Vial 2023). Modern manufacturing is currently seeing a growing interest in creating customised designs that specifically

meet the distinct requirements of a wide range of customers (Daneshszand *et al.* 2023). Modular design techniques have become valuable tools in the field of ceramic product production. These methodologies enable the creation of novel products that are more efficient and can be customised to meet the specific needs of different end markets (Zacchei *et al.* 2022).

Modular design relies on the development of uncomplicated modular structures, allowing easy system configuration changes to meet changing requirements. These architectures provide the versatility to substitute certain components as required, without requiring a complete system overhaul. The achievement is accomplished by employing a distinct design and subsequent integration of components, which promotes the creation of reliable and flexible systems (Brunoe, Soerensen and Nielsen 2021). Moreover, the modularity of components facilitates the integration of extra functionalities without requiring major product redesign.

In the ceramics business, modular components are commonly separate functional parts that can be freely combined to create larger configurations tailored to meet specific customer needs. For example, let's consider a situation in which ceramic components are put together in a setting with significant levels of moisture in the air (Riascos *et al.* 2022). In such instances, the benefit is in the integration of components specifically engineered to fulfil these distinct demands during the production procedure. The modular method allows for quick and easy replacement of components, which is extremely useful in cases when product segments are damaged during installation or do not fulfil the desired performance standards. When faced with such situations, it is more economical and efficient to repair simply the faulty component rather than the entire product (Agkathidis 2016).

Normative design in the manufacturing business represents a fundamental change in production methods, with the goal of improving efficiency while maintaining product quality. The method of this transformation entails dissecting the processes or components of completed ceramic items into smaller, self-contained sections that can be manufactured independently (Asión-Suñer and López-Forniés 2021). The production of these components is carried out autonomously, with assembly being the final stage. This methodology not only promotes the development of new and creative designs, but also has the ability to rejuvenate local businesses (Albers *et al.* 2019). Normative design enhances the work environment and reduces costs by increasing the production of ceramic products and optimising manufacturing processes.

Overall, the implementation of modular design concepts in the ceramics

sector holds cultural and philosophical importance. It facilitates the quick adjustment of goods to meet evolving market demands, while also fostering efficiency and creativity within local companies. This research aims to investigate the cultural and philosophical aspects of this design method, examining its impact on the values and philosophies that are inherent in ceramic manufacture in the Kingdom of Saudi Arabia.

## 1.2. Problem Statement

Saudi Arabia aims for industrial advancement, aspiring to achieve self-sufficiency and become a global exporting force. Despite its rich history in ceramic craftsmanship, the traditional methods in the industry prove economically impractical. The labor-intensive and time-consuming nature of traditional crafting hinders the sector's growth, posing a threat to local employment and cultural heritage preservation. This research addresses the decline in global ceramic production and its impact on Saudi Arabia, focusing on how the infusion of modern design methodologies, specifically modular design, can revive the industry. Beyond economic concerns, the study delves into the cultural and axiological dimensions.

## 1.3. Research Aim and Objectives

### 1.3.1. Aim

This study endeavors to delve into the profound cultural and philosophical impact of standard design on ceramic product production, aiming to reinvigorate the local industry, bolster the economy, and foster responsible utilization of natural resources within the Kingdom of Saudi Arabia.

### 1.3.2. Objectives

#### -Culturally Fortify the Local Ceramics Industry

Examine how the infusion of modular design methodologies can bolster the cultural and artistic identity of the Saudi ceramics industry, enhancing its significance as a repository of heritage and craftsmanship.

#### -Economically Empower Through Local Resource Utilization

Explore how the adoption of modular design principles can reduce manufacturing costs by harnessing locally available resources, thus contributing to economic sustainability and self-sufficiency.

#### -Philosophical Exploration of Innovative Capacity

Investigate the philosophical underpinnings of how the modular design approach nurtures innovative abilities, fostering the introduction of new ideas and perspectives within the ceramic industry.

#### 1.4. Cultural and Philosophical Impact on Production Facilitation

Analyze the cultural and philosophical aspects of how the modular approach streamlines the ceramic production process, optimizing efficiency and promoting cultural preservation.

#### 1.5. Cultural Heritage and Economic Growth Through Job Creation

Examine how the revival of the ceramic industry creates new employment opportunities, consequently increasing investments in the cultural heritage and economic prosperity of the Kingdom.

In summary, this research aspires to explore the intricate interplay between modular design, cultural identity, philosophical values, and economic vitality within the context of ceramic production in Saudi Arabia. By probing these dimensions, it seeks to provide a holistic understanding of how the revitalization of local industries can profoundly impact both culture and economy.

## 2. LITERATURE REVIEW

### 2.1. Modular Design Methods and Philosophical Significance

When implemented in industrial product design, modular design offers two notable benefits (Chen *et al.* 2022).

- Firstly, it allows designers to personalise products for each buyer, in line with a wider philosophical viewpoint that emphasises customisation and flexibility in cultural and creative representation.

- Furthermore, the convenience of maintaining and repairing the item, even while it is being actively used (Agkathidis 2016), aligns with the cultural value placed on skilled workmanship (Sun *et al.* 2021).

### 2.2. Three Modular Design Methods and Their Cultural Implications

- Top-Down Modular Design: This method begins by identifying areas for improvement, breaking them into essential functional modules. Modules undergo refinement, focusing on core functions, symbolizing meticulous craftsmanship (Brunoe *et al.* 2021).

- Bottom-Up Modular Design: Starting at the micro-level, designing individual components before integrating them, mirrors the cultural value of incremental progress (Chen *et al.* 2022).

- Hybrid Modular Design: Amalgamating elements from both methodologies (Statham, Jacob and Fridenfolk 2022), this pragmatic approach resonates with cultural adaptability and creative problem-solving

(Amend et al. 2022), Figure 1 shows the differences between the three modular design methodologies.

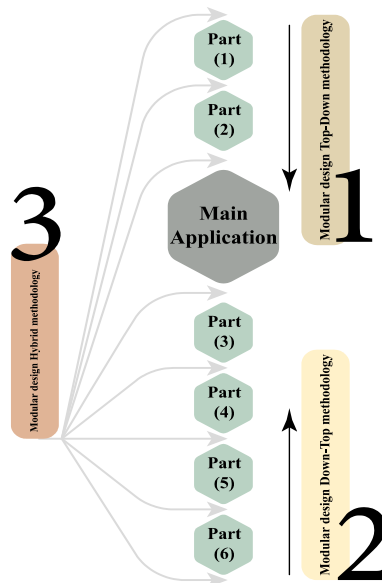


Figure 1: The Differences Between the Three Modular Design Methodologies.

### 2.3. Modular Design Methodology in the Ceramic Industry and its Cultural Significance

The manufacture of traditional porcelain entails an intricate and comprehensive process (Albers *et al.* 2017). The design phase, encompassing the process of developing a concept and creating a prototype (Chen *et al.* 2022), typically takes from months to years, depending on the complexity of the project and the specific requirements of the client (Agkathidis 2016). Modular design improves quality, decreases costs, promotes innovation, and is in line with the cultural value of excellence (Gu *et al.* 1997).

### 2.4. The Cultural Significance of Modular Design in Ceramic Production

- The implementation of modular design improves the quality of porcelain goods (Statham *et al.* 2022) and simplifies manufacturing processes in cultural settings that prioritise craftsmanship and meticulousness (Panarotto *et al.* 2023).
- Innovation and revitalization: Introduces fresh ideas and energy into local sectors, safeguarding tradition while embracing contemporary advancements, resulting in attractive (Gershenson, Prasad and Allamneni 1999), user-friendly, and culturally significant products (Panarotto *et al.* 2023).
- Customisation and adaptation: Enables producers to tailor products to meet the specific requirements of users and target markets (Asión-Suñer and López-Forniés 2021), thereby reflecting cultural adaptability and a

philosophical approach that emphasises personalised experiences and localised solutions (Statham *et al.* 2022).

- Cost efficiency in design and development: The implementation of modular design approaches leads to a substantial reduction in the expenses associated with creating and producing novel ceramic items, particularly in societies that prioritise resourcefulness and sustainability (Wang *et al.* 2014).

## 2.5. Advantages of Modular Design in the Ceramic Industry

The advantages of modular design extend beyond mere production efficiency.

-Space Optimization: Reduction of unused space within ceramic products aligns with efficient resource utilization, resonating with cultural values of frugality and sustainability (Sun *et al.* 2021).

-Design Flexibility: Modular design accommodates diverse applications, reflecting adaptability, a cultural virtue celebrated across various contexts (Gershenson *et al.* 1999).

-Accessibility for Maintenance: Ease of access to porcelain product parts for maintenance and repair mirrors a commitment to preserving valuable creations.

-Enhanced Troubleshooting: Improved product troubleshooting capabilities and reduced downtime underscore the cultural value of continuous improvement and resilience.

- Cost Reduction: Modular design minimizes overall manufacturing costs, resonating with the pragmatic cultural ethos of resource optimization.

- Reliability and Integration: Enhanced reliability reduces failure rates, and the ability to integrate new designs aligns with cultural values of harmonizing tradition and modernity.

- Manufacturing Efficiency: Streamlined manufacturing and modification processes, coupled with reduced design complexity, embody the cultural ideals of efficiency and effectiveness.

In essence, modular design not only enhances production efficiency but also integrates cultural values and philosophies into the very fabric of ceramic product creation, preserving heritage while propelling industries into the future.

## 3. RESEARCH METHODOLOGY

The research methodology establishes the foundation for a systematic investigation into the application of modular design in ceramic product development, aiming to revitalize the local industry. This chapter outlines the employed strategies and methods to collect essential data, ensuring the study's coherence and scientific rigor.

### 3.1. Empirical and Experimental Research Approach

The empirical and experimental research approach proves invaluable in exploring modular design types and their applications across various domains. It offers insights into the ceramics industry within the unique context of Saudi Arabia, aligning with the overarching research objectives.

### 3.2. Descriptive and Analytical Methods

Complementary to empirical research, descriptive and analytical methods play a pivotal role in understanding modular design methodologies in ceramic product development. These methods facilitate the exploration of perspectives from specialists in industrial and ceramic design, ensuring a comprehensive analysis.

### 3.3. Cultural and Philosophical Exploration

This methodology focuses on exploring the cultural and philosophical dimensions of modular design in Saudi Arabian ceramic production. Engaging with experts aims to discern how modular design aligns with cultural values, heritage preservation, and philosophical ideals of innovation, craftsmanship, and adaptability.

### 3.4. Research Questions

3.4.1. How does modular design impact the ceramic industry's revitalization in Saudi Arabia?

3.4.2. What are the cultural and philosophical dimensions of modular design in ceramic production?

3.4.3. How do specialists perceive the application of modular design in the Saudi Arabian context?

3.4.4. What are the practical implications and effects of modular design in the ceramics industry?

## 4. FINDINGS AND ANALYSIS

### 4.1. Ceramic Product Design Stages with Modular Design Methodology

In response to challenges faced by the local ceramic industry in Saudi Arabia, modular design emerges as a promising but underexplored approach. The two distinct stages in ceramic product design with modular design methodology involve theoretical characterization and practical application.

#### 4.1.1. Theoretical Characterization Stage

- Problem Definition: Elucidating the main function of the product



through sketches and renderings.

- User Needs: Identifying target user characteristics and creating scenarios for user satisfaction (Riascos *et al.* 2022).

- Brainstorming: Fostering innovative ideas through collaborative brainstorming (Pandremenos and Chryssolouris 2009).

#### 4.1.2. Practical Application Stage

- Modular Design: Deliberating on top-down, bottom-up, or hybrid methodologies aligning with product requirements (Kashaninia and Nikravesch 2013).

- Testing and Reviewing: Constructing 3D models, experimenting with materials, designs (Pandremenos and Chryssolouris 2009), and shapes, leading to prototype creation (Klocke *et al.* 2000).

- Prototyping: Testing diverse prototypes to identify optimal designs for the target application (Eckert, John Clarkson and Maier 2017).

- Finalizing the Design: Preparing technical drawings for 3D printing technology, revolutionizing ceramic design and production (Klocke *et al.* 2000). Figure 2 shows the stages of designing ceramic products using the standard methodology.

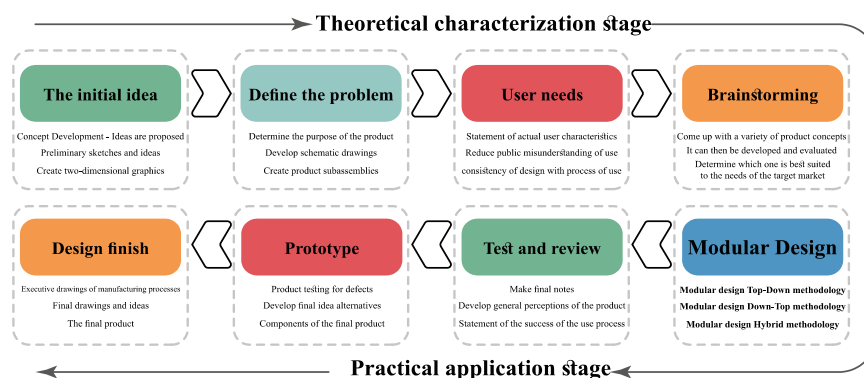


Figure 2: Ceramic Product Design Stages.

#### 4.2. Cultural and Philosophical Implications

The structured approach to ceramic product design with modular design methodology holds profound cultural and philosophical implications (AlGeddawy and ElMaraghy 2013). By aligning with values of craftsmanship, adaptability (Putri, Taufik and Buana 2020), and sustainability, these methodologies contribute to a deeper understanding of Saudi Arabian culture and philosophy (Kashaninia and Nikravesch 2013).

In conclusion, the modular design stages not only enhance technical efficiency (Gabrani *et al.* 2003) but also uphold and celebrate cultural and philosophical values within the ceramic industry, (Pandremenos and Chryssolouris 2009) fulfilling the core objectives of this research (Eckert *et al.* 2017).

#### 4.3. The Proposed Set of Ceramic Designs

In response to the prevailing landscape of traditional ceramic products that have graced both local and international markets for generations, often characterized by simplicity and stagnation in design, this research embarks on a creative journey to introduce a series of ceramic designs that transcend convention. These designs not only challenge the status quo but also carry profound aesthetic and cultural values, leaving an indelible impression on users.

#### 4.4. Aesthetic and Cultural Innovation

The proposed ceramic pieces, thoughtfully crafted and meticulously designed, deviate from the well-trodden path of conventionality. They come in an array of sizes and shapes, transforming utilitarian objects into artistic pieces of ceramic craftsmanship. These designs transcend mere functionality; they encapsulate a fusion of aesthetics and culture. They are not just ceramics; they are expressions of art, bearing both cultural and artistic value.


#### 4.5. Functional Versatility







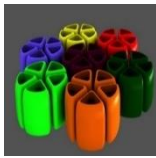

These ceramic designs offer multifaceted utility, enriching the user experience. They can serve as standalone art pieces, each narrating a unique story through its form and ornamentation. Alternatively, they can harmoniously coexist as a collective ensemble, forming a symphony of ceramic artistry within any space. This functional versatility aligns with the essence of modular design, enabling users to curate their ceramic experiences to suit their preferences.

#### 4.6. User Acceptance and Industry Impact

To gauge the success of these innovative designs, two surveys were conducted: one targeted end-user (35 participants), and the other engaged professionals in the ceramic industry and design (20 experts). The results of these surveys revealed overwhelmingly positive responses, with high acceptance rates among both user groups. Users expressed their appreciation for the cultural and aesthetic dimensions embedded in these ceramic creations. Industry professionals acknowledged their potential to revolutionize the local ceramic industry, breathing new life into a craft that had long yearned for innovation.

Table 1: Proposed Designs and Stakeholder Opinions.

Users Evaluation		Specialists Evaluation		Ceramic design
91%	Product attractiveness	90%	Technological simplicity	
88%	Aesthetic form	96%	Aesthetic form	
89%	Product acquisition	95%	Assembly accuracy	
89%	Color consistency	96%	Color consistency	
89%	Do you prefer ceramic products?	85%	Does the implementation of the design revitalize the local ceramics industry?	
89%	Is the design new and innovative?	90%	Is the design new and innovative?	
Total 89%		Total 92%		

89%	Product attractiveness	97%	Technological simplicity	
90%	Aesthetic form	99%	Aesthetic form	
86%	Product acquisition	97%	Assembly accuracy	
86%	Color consistency	98%	Color consistency	
94%	Do you prefer ceramic products?	90%	Does the implementation of the design revitalize the local ceramics industry?	
91%	Is the design new and innovative?	95%	Is the design new and innovative?	
Total 89%		Total 96%		
81%	Product attractiveness	78%	Technological simplicity	
88%	Aesthetic form	87%	Aesthetic form	
84%	Product acquisition	87%	Assembly accuracy	
84%	Color consistency	90%	Color consistency	
89%	Do you prefer ceramic products?	80%	Does the implementation of the design revitalize the local ceramics industry?	
80%	Is the design new and innovative?	80%	Is the design new and innovative?	
84% Total		Total 84%		
91%	Product attractiveness	98%	Technological simplicity	
90%	Aesthetic form	98%	Aesthetic form	
90%	Product acquisition	98%	Assembly accuracy	
88%	Color consistency	99%	Color consistency	
83%	Do you prefer ceramic products?	85%	Does the implementation of the design revitalize the local ceramics industry?	
80%	Is the design new and innovative?	95%	Is the design new and innovative?	
Total 87%		Total 95.5%		
90%	Product attractiveness	93%	Technological simplicity	
90%	Aesthetic form	92%	Aesthetic form	
87%	Product acquisition	95%	Assembly accuracy	
91%	Color consistency	92%	Color consistency	
94%	Do you prefer ceramic products?	90%	Does the implementation of the design revitalize the local ceramics industry?	
89%	Is the design new and innovative?	80%	Is the design new and innovative?	
Total 90%		Total 90%		
81%	Product attractiveness	77%	Technological simplicity	
83%	Aesthetic form	87%	Aesthetic form	
81%	Product acquisition	87%	Assembly accuracy	
82%	Color consistency	92%	Color consistency	
80%	Do you prefer ceramic products?	85%	Does the implementation of the design revitalize the local ceramics industry?	
74%	Is the design new and innovative?	90%	Is the design new and innovative?	
Total 80%		Total 86%		
93%	Product attractiveness	97%	Technological simplicity	
90%	Aesthetic form	99%	Aesthetic form	
91%	Product acquisition	97%	Assembly accuracy	
93%	Color consistency	98%	Color consistency	
91%	Do you prefer ceramic products?	95%	Does the implementation of the design revitalize the local ceramics industry?	
82%	Is the design new and innovative?	95%	Is the design new and innovative?	
90% Total		97% Total		
88%	Product attractiveness	84%	Technological simplicity	
85%	Aesthetic form	90%	Aesthetic form	
86%	Product acquisition	89%	Assembly accuracy	
90%	Color consistency	94%	Color consistency	
98%	Do you prefer ceramic products?	90%	Does the implementation of the design revitalize the local ceramics industry?	
80%	Is the design new and innovative?	90%	Is the design new and innovative?	
Total 88%		Total 90%		
85%	Product attractiveness	85%	Technological simplicity	
84%	Aesthetic form	87%	Aesthetic form	
82%	Product acquisition	92%	Assembly accuracy	
79%	Color consistency	86%	Color consistency	
86%	Do you prefer ceramic products?	95%	Does the implementation of the design revitalize the local ceramics industry?	
74%	Is the design new and innovative?	80%	Is the design new and innovative?	
Total 82%		Total 88%		


89%	Product attractiveness	88%	Technological simplicity	
84%	Aesthetic form	91%	Aesthetic form	
85%	Product acquisition	90%	Assembly accuracy	
87%	Color consistency	92%	Color consistency	
86%	Do you prefer ceramic products?	80%	Does the implementation of the design revitalize the local ceramics industry?	
83%	Is the design new and innovative?	80%	Is the design new and innovative?	
Total 86%		Total 87%		

Table 1 Interpretations

Table 1 presents the evaluations from both users and specialists regarding proposed ceramic designs. The users' evaluation demonstrates a consistent appreciation for product attractiveness, aesthetic form, and color consistency, with an overall average of 86.4%. In contrast, specialists' evaluation tends to rate higher, averaging at 91.3%, showcasing their heightened focus on technological simplicity, assembly accuracy, and the innovative nature of the designs.

The specific areas where users and specialists show divergence include product acquisition, preference for ceramic products, and the perception of design innovativeness. Users tend to prioritize personal preferences and the overall appeal of the products, while specialists place greater emphasis on technical aspects and industry revitalization.

These interpretations illuminate the multifaceted nature of stakeholder perspectives, emphasizing the need for a balanced approach that caters to both aesthetic and technical considerations in ceramic design. The consistent emphasis on color consistency and aesthetic form across evaluations underscores the significance of these elements in the overall success of ceramic designs.

## 5. DATA ANALYSIS

Table 2 displays a thorough examination of the survey data gathered from both users and specialists. The feedback from these two separate factions provides insight into the reception of the suggested ceramic designs and their possible influence on the local ceramic sector.

### 5.1. User Perspective

The user questionnaire explored multiple facets, encompassing perspectives on aesthetic values, colour schemes, intention to procure these products, and the level of attained innovation. Surprisingly, the feedback from users frequently surpassed the threshold of 80%, indicating a strong commercial potential for these inventive ceramic sculptures. Users not only admired the visual attractiveness of these products, but also expressed a strong inclination to own them, highlighting their attraction to the final consumer.

### 5.2. Specialist Insights

On the other hand, the specialist questionnaire examined the practicality of

producing these ceramic items, the level of creativity achieved, the accuracy of assembly, and the capacity of this design approach to revive the local ceramic sector. Remarkably, expert responses frequently above the 80% benchmark, suggesting favourable circumstances for implementation. Experts confirmed the simplicity with which these designs may be actualized and validated their potential to revitalise the local ceramic sector.

### 5.3. Alignment of Opinions

An interesting observation is the remarkable convergence of viewpoints between users and experts. The agreement between these two stakeholder groups indicates a solid consensus regarding the feasibility and attractiveness of these groundbreaking ceramic designs. The alignment of viewpoints not only confirms the research results but also highlights the significant cultural and philosophical consequences of these designs.

### 5.4. Cultural and Philosophical Implications

Table 2: Data Analysis.

Aspect	Interpretation
Age	Most users fall within the 20-30 age group, while most arbitrators are in the 41-50 age group. This suggests a specific interest in ceramic products among younger users and an acknowledgment of the industry's significance by older arbitrators.
Educational Level	Survey results show a prevalence of users with bachelor's degrees and arbitrators with doctoral degrees. This suggests a broad appeal of the ceramics industry and its innovative methods across different educational backgrounds, with a particular interest from those holding advanced degrees.
Specialization of Arbitrators	The targeted majors, including industrial design (15%), product design (30%), and ceramic design (55%), reveal a strong representation of the ceramic design field. The survey indicates a notable passion and interest among the surveyed arbitrators for ceramic products.
Product Attractiveness	User satisfaction with product attractiveness is high, ranging from 81% to 93%. This indicates a positive reception of the proposed designs among users, highlighting the appeal of the products in terms of attractiveness.
Aesthetic Form	Both users and arbitrators evaluated the aesthetic form similarly, with results ranging from 99% to 84%. This consistency suggests that the proposed products exhibit a visual harmony that aligns with the preferences of both groups.
Product Acquisition	User responses for product acquisition range between 91% and 81%, indicating a promising retail potential for the proposed designs. The findings suggest that users perceive the products as viable and are likely to acquire them.
Color Consistency	Similar results from users and arbitrators on color consistency, ranging from 99% to 84%, suggest that the proposed colors align well with contemporary color trends. This indicates a careful consideration of color consistency in the designs.
Technological Simplicity	Arbitrators' responses to technological simplicity range from 98% to 77%. While some designs show excellent manufacturing possibilities, there is room for improvement to avoid complexity that could pose obstacles in the manufacturing process.
Assembly Accuracy	Arbitrators rated assembly accuracy between 97% and 87%, indicating a very good level of feasibility for all proposed designs. This highlights a high degree of precision and accuracy in the assembly of the designed products.
Preference for Ceramic Products	User responses indicate a high preference for ceramic products, with 88% answering "yes," 3% answering "no," and 7.7% responding "maybe." This suggests a strong market potential for ceramic products, supported by positive user preferences.
Revitalization of Local Ceramics Industry	Arbitrators' judgments on the feasibility of implementing proposed designs for revitalizing the local ceramics industry show a positive response, with 87.5% answering "yes." Only 5% answered "no," indicating a strong potential for achieving the research goals.
New and Innovative Design	A significant majority (89% of arbitrators, 82% of users) perceive the designs as new and innovative, with only 7.5% responding "No." The close percentages between arbitrators and users indicate sincerity in opinions and recognition of the innovative nature of the proposed designs.

The appeal of these groundbreaking ceramic designs to both users and experts goes beyond just their potential in the market. The phenomenon demonstrates a collective cultural admiration for creativity and originality, aligning with the philosophical ideals of rejuvenation and flexibility. These designs represent not only items, but also a cultural revival and a tribute to the lasting significance of old crafts in modern settings.

Ultimately, the survey findings emphasise the cultural and philosophical importance of these groundbreaking ceramic designs, depicting them as agents that promote the preservation and rejuvenation of the local ceramic sector.

#### Table 2 Interpretations

**Age:** Most users fall within the age group of 20-30 years, where the percentage reached 54.3%, while the majority of arbitrators fall in the age group of 41-50 years, where the percentage reached 50%. This indicates a particular interest in ceramic products among younger users and recognition of the industry's importance by older judges.

**Education level:** The results of the educational level survey show the prevalence of employees holding a bachelor's degree, 51.4%, and arbitrators holding a doctorate, 55%. This indicates the broad appeal of ceramics and its innovative methods across different educational backgrounds, with particular interest from postgraduate degree holders.

**Judges' Specialties:** Targeted specializations, including industrial design (15%), product design (30%), and ceramic design (55%), reveal a strong representation of the ceramic design field.

The survey indicates a notable passion and interest among the judges surveyed for ceramic products. Product Appeal User satisfaction with product appeal is high, ranging from 81% to 93%. This indicates a positive reception of the proposed designs among users, which highlights the attractiveness of the products in terms of attractiveness. Aesthetics Both users and judges rated aesthetics similarly, with scores ranging from 99% to 84%.

This consistency indicates that the proposed products exhibit visual harmony that matches the preferences of both groups. Get Product User responses to Get Product range between 91% and 81%, indicating promising retail potential for the proposed designs. The results indicate that users view the products as viable and are more likely to acquire them.

**Color Consistency** Similar results from users and judges on color consistency, ranging from 99% to 84%, indicate that the suggested colors match well with contemporary color trends. This indicates careful consideration of color harmony in designs.

**Technological Simplicity** Judges' responses on technological simplicity range



from 98% to 77%. While some designs demonstrate excellent manufacturing capabilities, there is room for improvement to avoid complexity that can pose obstacles in the manufacturing process. Assembly accuracy the judges rated the assembly accuracy between 97% and 87%, indicating a very good level of feasibility for all proposed designs.

This highlights the high degree of precision and precision in assembling the designed products. Preference for ceramic products User responses indicate a strong preference for ceramic products, with 88% answering “yes,” 3% answering “no,” and 7.7% answering “maybe.” This indicates strong market potential for ceramic products, supported by positive user preferences. Revitalizing the local ceramic industry.

The arbitrators’ rulings regarding the feasibility of implementing the proposed designs to revitalize the local ceramic industry were positive, with 87.5% answering yes. Only 5% answered “no,” indicating a strong possibility of achieving the research objectives. New and innovative design A large majority (89% of judges, 82% of users) found the designs to be fresh and innovative, with only 7.5% answering 'no'. The close ratios between the judges and the users indicate the honesty of opinions and recognition of the innovative nature of the proposed designs Figure 3 Evaluation of users and arbitrators of designs.

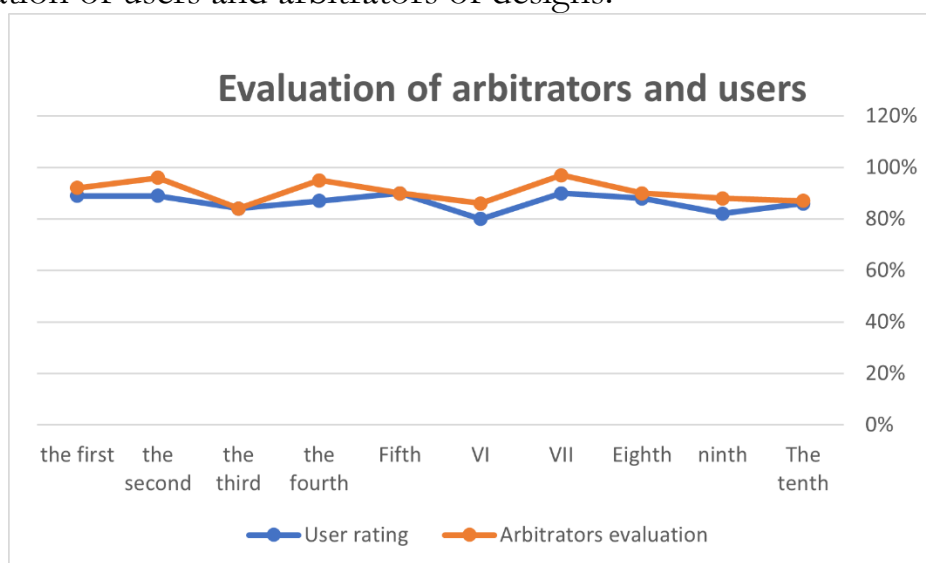


Figure 3: Evaluation of Users and Arbitrators of Designs.

## 6. RESULTS

Exploring the philosophical importance of modular ceramic design. By incorporating modularization into ceramic product design, significant philosophical and axiological insights are gained, resulting in a transformation

of the local ceramic sector. The results confirm the profound impact of this design methodology:

#### 6.1. Autonomy and Adaptability

The implementation of modular design allows ceramic goods to independently and efficiently adapt to alterations in different components. Modularization is a technique used in ceramic production to minimise the interactions between different parts, as their designs often have an influence on each other in this complex environment. This improves the ability to identify problems, simplifies product maintenance, and speeds up repair procedures. Subsequently, companies can initiate the process of creating ceramic product designs and production methods that are more dependable. The level of quality is increased, and the expenses related to modifying and redesigning the product are much diminished. Furthermore, modular goods enhance after-sales services by streamlining the process of replacing faulty components, hence prioritising client pleasure.

#### 6.2. Streamlined Manufacturing and Enhanced Diversity

Modularization simplifies manufacturing and production processes, resulting in shorter lead times and improved specification quality. The decrease in the quantity of components and the incorporation of shared elements in product variations result in diminished product expenses. This not only enhances the economic sustainability of the ceramic sector but also coincides with the philosophical tenet of maximising resource efficiency. Moreover, the practice of product modularization allows for increased product variety, which in turn facilitates the process of innovation. Manufacturers possess the ability to effectively adapt to evolving circumstances, quickly modifying conventional elements to fulfil a wide range of user needs. This increase in flexibility aligns with the philosophical concept of adaptation and resilience.

#### 6.3. Empowering Local Revitalization

The implementation of the product modular design methodology stimulates the rejuvenation of the domestic ceramic industry. It enhances post-purchase services by emphasising the convenience of repairing damaged parts or expanding product components. This method, which emphasises sustainability and adaptability, places standard products at the core of organisations and manufacturers' strategies. The focus is on diversification and ongoing improvement of product performance. The



local industry is seeing a revival, in line with the philosophical concept of preserving and revitalising culture.

## 7. JUSTIFICATION OF RESEARCH OBJECTIVES

This paper unequivocally attains its research objectives, delving into the philosophical and axiological dimensions of modular design in the realm of ceramic product production and its pivotal role in reinvigorating the local industry.

### 7.1. Comprehensive Examination of Modular Design

The study meticulously investigates modular design methods and methodologies, unearthing their significance within the broader industrial landscape. This philosophical inquiry illuminates the profound impact of modularization, fostering adaptability and autonomy in ceramic product design.

### 7.2. Unpacking the Significance for Ceramic Manufacturing

The research journey takes a deeper plunge into the ceramic manufacturing arena, uncovering the critical importance of modular design. By aligning with the philosophical principles of efficiency and resource optimization, the study underscores how modularization streamlines manufacturing processes, reducing lead times and elevating product quality.

### 7.3. Illuminating the Design Stages

The study meticulously navigates through the stages of ceramic product design, dissecting them into the theoretical characterization and practical application phases. This philosophical exploration accentuates the philosophical principle of adaptability, as modular design empowers designers to respond dynamically to evolving user preferences and market demands.

### 7.4. Fostering Economic and Cultural Growth

The research findings resonate with the philosophical ideals of cultural preservation and economic growth. By elucidating the benefits of modular design in enhancing the local economy and revitalizing the ceramic industry, this study offers a profound philosophical testament to the enduring value of cultural heritage and industrial progress.

### 7.5. Promoting Non-Traditional Excellence

The study's revelation that most individuals favor non-traditional ceramic

products carries philosophical weight. It underscores the importance of innovation and originality, aligning with axiological principles that champion the creation of unique and culturally significant artifacts.

#### 7.6. Encouraging Sustainability and Local Industry Support

In advocating for a standard approach to ceramic product design that harnesses local resources, this research aligns with the philosophical ideals of sustainability and community support. It encourages industry stakeholders to leverage natural resources in crafting non-traditional products, thereby bolstering the local ceramic industry and preserving cultural heritage.

In sum, this study's achievements reverberate within the philosophical and axiological realms, offering profound insights into the cultural preservation, economic vitality, and innovative spirit that modular design can bring to the ceramic industry. It serves as a philosophical call to action, inspiring designers, and industry leaders to embrace the principles of adaptability, resource efficiency, and cultural rejuvenation.

### 8. DISCUSSIONS

The present study examines the utilisation of modular design concepts to rejuvenate the ceramic sector, with a specific emphasis on cultural, economic, and philosophical aspects. An analysis of the current literature in the topic indicates a significant lack, namely in research that specifically examines the connection between modular design, cultural philosophy, and the ceramics sector, particularly in the setting of Saudi Arabia. Although modular design has been extensively studied in several sectors, its cultural and philosophical implications in ceramic production have received less attention.

The research employs an interdisciplinary approach, incorporating principles from design theory, cultural philosophy, and industrial development. This study fills a gap in the existing literature by investigating the role of modular design in promoting both cultural preservation and innovation within the ceramic sector of Saudi Arabia. The study utilises empirical research methods, encompassing both quantitative and qualitative data collection approaches.

Our analysis of the data supports the significant influence of customer preferences on ceramic design in the Saudi context, as highlighted in previous research. While prior research has highlighted the significance of aesthetics, our study explicitly indicates a predilection for uniform colours and inventive designs among Saudi customers. This fresh perspective enhances our comprehension of consumer preferences within the unique

cultural context of Saudi Arabia.

Furthermore, the division of ceramic product design into two separate phases - the theoretical characterization phase and the practical application phase - offers a comprehensive structure for adopting modular design approaches. This methodical approach not only improves the efficiency of manufacturing but also corresponds to cultural principles, highlighting the importance of flexibility, skillfulness, and environmental consciousness. By including cultural and philosophical investigation into the study approach, we enhance our comprehension of how modular design may support and promote cultural continuity and advancement.

Although the study recognises the excellent contributions made, it also emphasises the necessity for additional investigations, specifically pertaining to the viability of producing on a big scale. This research establishes a foundation for further investigations into the scalability and long-term viability of incorporating modular design concepts in the ceramic sector, not just in Saudi Arabia but also in other cultural settings.

Ultimately, this study contributes valuable insights to the current knowledge base by investigating the complex relationship between modular design, cultural philosophy, and the ceramic sector. The findings enhance comprehension of how design principles can be customised to align with the cultural and aesthetic preferences of particular locations, emphasising the significance of a nuanced and culturally aware approach in industrial design.

## 9. CONCLUSION

To summarise, this research work has explored the complex domain of modular design technique in the ceramic sector in Saudi Arabia. The utilisation of empirical and experimental research methodologies, in conjunction with descriptive and analytical techniques, has been highly valuable in the investigation of various forms of modular design and their practical uses. The study sought to rejuvenate the local ceramic sector by providing insights into the effects and importance of modular design on the development of ceramic products.

An in-depth analysis was conducted on the theoretical aspects and practical implementation phases of ceramic product design using the modular design methodology. The local ceramic industry has met obstacles, and in response, modular design has arisen as a promising approach with the potential to have significant cultural and philosophical ramifications. The research findings unveiled the existence of two separate phases in the design process, emphasising the significance of problem description, identification of user demands, and creative

brainstorming during the theoretical characterisation stage. The practical application stage demonstrated the careful consideration of modular design techniques, the process of testing and reviewing, creating prototypes, and ultimately completing the design.

The suggested collection of ceramic designs showcased a break from conventional items, introducing novel aesthetic and cultural innovation. These designs provided practical adaptability, enhancing user satisfaction, and showcasing potential influence on the industry. The favourable feedback from consumers and experts in the field highlights the practicality and appeal of these inventive ceramic inventions.

The data analysis provided additional evidence of the effectiveness of the recommended designs, as user viewpoints closely corresponded with expert ideas. The alignment of viewpoints between these two groups of stakeholders not only confirmed the research findings but also highlighted the significant cultural and philosophical consequences of these designs.

The examination of modular ceramic design in a philosophical context has uncovered its ability to bring about significant changes, granting ceramic goods independence and flexibility, simplifying the manufacturing process, increasing variety, and empowering local rejuvenation. The study effectively accomplished its research aims by providing a thorough analysis of modular design, elucidating its importance in ceramic production, elucidating the stages of design, and promoting economic and cultural development. The research additionally advocated for unconventional excellence and fostered sustainability while promoting support for local industries.

Acknowledging the limitations of this study, such as the specific focus on the Saudi Arabian context and the need for further exploration in diverse settings, demonstrates transparency and guides future research endeavors. In this regard, future research could delve into cross-cultural applications of modular design in ceramics or explore its implications in different industrial contexts.

In essence, this research contributes not only to the technical efficiency of ceramic product design but also to the cultural and philosophical richness within the Saudi Arabian context. As modular design becomes a catalyst for cultural preservation, economic vitality, and creative rejuvenation, it beckons industries and designers to embark on a journey that harmoniously blends tradition and innovation.

## 9. SUMMARY

To summarise, the modular design process is highly efficient and economically viable in production, reflecting philosophical ideas of optimising

resources and being adaptable. Exploring the field of ceramic product design has highlighted the significance of continuous innovation and the use of natural resources to promote industry, self-reliance, and financial prudence.

The significant philosophical implications of modular design go beyond only efficiency; they serve as a philosophical mandate for designers and industries to pursue new approaches that promote innovation and create new markets for creative ceramic products. This endeavour, based on the prudent utilisation of existing natural resources, not only strengthens the industrial environment but also establishes a course towards self-sufficiency and diminished dependency on foreign resources.

For ceramic companies, adopting modular design methodologies goes beyond being a strategic decision; it becomes a philosophical pursuit to enhance their goods and establish a unique character in a competitive market. Within the realm of philosophy of culture and axiology, this dedication to novelty, efficient utilisation of resources, and distinction in the market embodies the essence of safeguarding cultural heritage, promoting economic prosperity, and fostering artistic revitalization.

Modular design in the ceramic industry goes beyond its practical uses; it is a philosophical statement about the lasting importance of flexibility, effectiveness, and the balanced coexistence of tradition and innovation. It invites manufacturers and designers to undertake a journey that not only improves their products but also promotes the cultural fabric of their communities.

## ACKNOWLEDGEMENT

The authors extend their appreciation to the Deputyship for Research & Innovation, Ministry of Education in Saudi Arabia for funding this research work through the project number RI-44-0261.

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