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Enhancing Design Ideation in Traditional Arabian Gulf Artifacts Through the Integration of Contemporary Three-Dimensional Manufacturing Methods

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ABSTRACT

The contemporary designer analyzes and studies the elements of artistic heritage, to identify the intellectual and aesthetic premises that lie in its structure, its elements, its vocabulary, and its encapsulation. With the aim of enriching the design thinking and its sources for the designer and raising the level of creativity and the overall idea of the two- and three-dimensional work, to design artistic models that are original and contemporary, enriching the language of communication between heritage and contemporary.

In this way, the heritage and its elements are inspired by a special stylistic display of heritage and its elements in innovative modernist formulations that deviate from the prevailing through its holistic images. And its presentation of elements or processes connected to each other and not as separate parts, to present it in a comprehensive form that supports the opportunities for selection and innovation that stems from it. In addition to those works in which some artists and designers deliberately elevated nature and its elements, drawing inspiration from its elements (human, plant, animal).

And simulating them as a basis for artistic formulation, another group of designers sided with drawing inspiration from the elements of Arab heritage, especially in the traditional Arab Gulf artifacts. As a source for enriching the architecture of 2D and 3D designs, And the design of modern models based on the reading comprehension of the philosophical, aesthetic, and structural dimensions of the elements of that heritage.

Increasingly traditional crafts of the gulf region are becoming obsolete because of dwindling numbers of traditional craftsmen and cheap imports from Pakistan and Morocco. There is a need to preserve traditional artefacts in the face of this issue.

This research assesses the viability of preserving the traditional Arab Gulf artifacts Using modern 3D manufacturing techniques added to maintain Traditional attributes of the original artifact. The methodology included consideration of requirements based on functionality, aesthetics and traditional elements, and the viability of techniques of such requirements in addition to practical and cost considerations.

Where the study seeks to provide inputs and examines the intellectual and aesthetic premises of the elements of heritage arts, especially the creative and aesthetic arts. In the artistic artifacts in the heritage Arab Gulf region of an artistic, aesthetic, and structural nature, with richness and diversity in the formal and structural forms of traditional Arab Gulf metal products.

As daily life tools such as jugs, trays, incense burners, candlesticks, bowls, cans, dallahs, irons, mirrors, and other metallic artifacts, which represents a fertile source of inspiration, and fertilizes the imagination of the Arab designer to put forward contemporary Arab visions and proposals to enrich design thinking in traditional Arab and Gulf handicrafts and recycling daily life products.

And the analytical study of the methods of forming technical design products, their forms and design construction, the materials through which they were designed and formulated, the traditional and new molding methods and techniques, the manufacturing materials, and the surface decorations and textures that dealt with the design plane. To raise the level of creativity and idea, to be inspired by heritage through a special style Heritage and its elements are presented in innovative modernist formulations.

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تعزيز أساليب التصميم في المنتجات التقليدية لمنطقة الخليج العربي من خلال دمج تقنيات التصنيع ثلاثية الأبعاد الحديثة

رأفت بن صالح سليمان مدني[1]

الملخص:

يتحلل المصمم المعاصر ويدرس عناصر التراث الفنّي، لتحديد المقوّمات الفكرية والجمالية الكامنة في بنيتها، عناصرها، مفرداتها، وتجميعها، بهدف إثراء التفكير التصميمي ومصادره للمصمم، ورفع مستوى الإبداع والفكرة في العمل ثنائي وثلاثي الأبعاد، لتصميم نماذج فنية أصيلة ومعاصرة، تثري لغة التواصل بين التراث والمعاصرة.

يستلهم التراث وعناصره عرضًا أسلوبيًا خاصًا للتراث وعناصره في صيغ حديثة مبتكرة تتجاوز السائدة من خلال صورها الشاملة، وعرضها لعناصر أو عمليات ترتبط ببعضها البعض وليس كأجزاء منفصلة، لتقديمها في شكل شامل يدعم الفرص للاختيار والابتكار النابع منه.

تقدم الدراسة تقييمًا لجدوى الحفاظ على القطع التقليدية العربية من الخليج باستخدام تقنيات التصنيع ثلاثية الأبعاد المعاصرة، للحفاظ على السمات التقليدية للقطعة الأصلية، من خلال تحليل المتطلبات القائمة على الوظائف والجماليات والعناصر التقليدية، وجدوى تقنيات هذه المتطلبات بالإضافة إلى الاعتبارات العملية والتكلفة.

بالإضافة إلى تحليل أساليب تشكيل المنتجات التقنية التصميمية وبنائها والمواد والطرق التقليدية والجديدة، والزخارف والأنسجة التي تعاملت معها الطائفة التصميمية، لرفع مستوى الإبداع والفكرة، والاستلهام من التراث من خلال أسلوب خاص يعرض التراث وعناصره بصيغ مبتكرة حديثة.

كلمات مفتاحية: المنتجات التقليدية، تقنيات التصنيع ثلاثية الأبعاد الحديثة.

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INTRODUCTION

The contemporary designer analyzes and studies the elements of artistic heritage, to identify the intellectual and aesthetic premises that lie in its structure, its elements, its vocabulary, and its encapsulation. With the aim of enriching the design thinking and its sources for the designer and raising the level of creativity and the overall idea of the two- and three-dimensional work, to design artistic models that are original and contemporary, enriching the language of communication between heritage and contemporary.

In this way, the heritage and its elements are inspired by a special stylistic display of heritage and its elements in innovative modernist formulations that deviate from the prevailing through its holistic images. And its presentation of elements or processes connected to each other and not as separate parts, to present it in a comprehensive form that supports the opportunities for selection and innovation that stems from it. In addition to those works in which some artists and designers deliberately elevated nature and its elements, drawing inspiration from its elements (human, plant, animal).

And simulating them as a basis for artistic formulation, another group of designers sided with drawing inspiration from the elements of Arab heritage, especially in the traditional Arab Gulf artifacts. As a source for enriching the architecture of 2D and 3D designs, And the design of modern models based on the reading comprehension of the philosophical, aesthetic, and structural dimensions of the elements of that heritage, (Al-Tayesh, Ali Ahmed .2000). Increasingly traditional crafts of the gulf region are becoming obsolete because of dwindling numbers of traditional craftsmen and cheap imports from Pakistan and Morocco. There is a need to preserve traditional artefacts in the face of this issue.

This research assesses the viability of preserving the traditional Arab Gulf artifacts Using modern 3D manufacturing techniques added to maintain Traditional attributes of the original artifact. The methodology included consideration of requirements based on functionality, aesthetics and traditional elements, and the viability of techniques of such requirements in addition to practical and cost considerations.

Where the study seeks to provide inputs and examines the intellectual and aesthetic premises of the elements of heritage arts, especially the creative and aesthetic arts. In the artistic artifacts in the heritage Arab Gulf region of an artistic, aesthetic, and structural nature, with richness and diversity in the formal and structural forms of traditional Arab Gulf metal products.

As daily life tools such as jugs, trays, incense burners, candlesticks, bowls, cans, dallahs, irons, mirrors, and other metallic artifacts, which represents a fertile source of inspiration, and fertilizes the imagination of the Arab designer to put forward contemporary Arab visions and proposals to enrich design thinking in traditional Arab and Gulf handicrafts and recycling daily life products.

And the analytical study of the methods of forming technical design products, their forms and design construction, the materials through which they were designed and formulated, the traditional and new molding methods and techniques, the manufacturing materials, and the surface decorations and textures that dealt with the design plane. To raise the level of creativity and idea, to be inspired by heritage through a special style Heritage and its elements are presented in innovative modernist formulations.

STATEMENT OF THE PROBLEM

Study and analysis of the structural and aesthetic values of the traditional Gulf Arab handicrafts through their aesthetic and structural patterns. And what it possesses of richness and formal diversity of traditional Arab and Gulf metal products, such as daily life tools such as jugs, trays, incense burners, candlesticks, cans, dallahs, iron iron and mirrors,….And other metal works, a review of the design solutions and treatments that the designer used to harmonize between the design and functional aspects.

In every harmonious issue, the privacy and uniqueness of Arabic products and artifacts.

Where the traditional Gulf Arab artifacts represent one of the most important sources from which the international designer in general, and the Arab in particular, is inspired to present his ideas and practical three-dimensional proposals. And the selection of materials, tools, techniques, and color preferences, with the aim of enriching design thinking in the traditional Arab and Gulf artifacts. and re-manufacturing the products of daily life in a contemporary modern way that stems from the local and re-reading the implicit content, philosophy, and values of heritage, (Lodes, M. Guschlbauer, R. Korner, C. 2015). as a kind of designer's renewal of his tools and capabilities, updating his sources of inspiration, and raising the level of creativity and idea. Providing a visualization of real 3D sensors It has a variety of sizes and materials that suit the form, function and place, and keep pace with the new technical language of the era, and bring pleasure to the user.

To determine the problem of the study in the following main question:

Is it possible through the study and analysis of modern three-dimensional additive manufacturing techniques to enrich the design thinking of traditional Arab and Gulf artifacts??

HYPOTHESES OF THE STUDY

- The study and analysis of modern 3D additive manufacturing techniques is an introduction to enriching the design thinking of traditional Arab and Gulf artifacts.

OBJECTIVES OF THE STUDY

1- Study, analysis and refute modern 3D additive manufacturing techniques

2- Studying the artistic and aesthetic values of the traditional Gulf Arab artifacts and their features and characteristics, to support design thinking in the traditional Gulf Arab handicrafts, and design proposals characterized by Saudi specificity that combine authenticity and contemporary.
3- Benefiting from the cultural heritage in confirming the Saudi identity.

SIGNIFICANCE OF STUDY

1- Revealing the interrelationship of the relationship between modern 3D additive manufacturing techniques and design thinking.
2- Preserving the identity and privacy in artistic artifacts and supporting the values and authenticity of the past and contemporary features and technologies.
3- Confirming the role of visual arts in preserving heritage and studying its artistic and aesthetic value.

THE LIMITS OF THE STUDY

A study of the analysis of a group of traditional Arab and Gulf artifacts based on the study of the characteristics and characteristics of that style.
Objective limits: Design thinking, 3D additive modern manufacturing techniques, traditional Arab Gulf artifacts, 3D design.
Temporal limits: The temporal limits of the current research are represented in the traditional artistic artifacts in the Arab region, especially the Gulf region.
Spatial boundaries: Traditional Gulf Arab artifacts in many Gulf Arab countries and cultures.

TERMINOLOGY OF STUDY

1.1. Modern Additive Manufacturing Techniques

Addition manufacturing is a term referring to that area of industrial processes in which an object or piece is constructed by adding layers of material layer by layer. These processes differ from the so-called "removal manufacturing" or "blending and solidifying" processes. In removal manufacturing processes, such as milling, turning, and perforating, preplanned motions of the cutting tool are used to remove portions of material from the workpiece. To obtain the desired shape of the piece. In mixing and solidification processes, such as casting and moulding, a specially designed and designed method or method is used to harden the material to obtain the desired shape. On the other hand, in addition, the manufacturing process does not require a special means or planning for the movement of the cutting tool. Instead, the body is directly built with a 3D digital model created with the help of computer-aided design software.

1.2. Design Thinking:

The term (Design Thinking) represents a methodology based on finding solutions and innovation focused mainly on people, Design thinking is a set of processes and strategies to solve problems in a creative way, and it is one of the common concepts in contemporary and applied design. in business and management. Design thinking also includes providing guidance for setting goals in design and for solving problems more creatively,(Griffiths, L. 2018) . With the aim of providing participants with a deep understanding of the principles and processes of design thinking, how to apply its methodology and tools to generate creative ideas and how to employ these methodologies to build workable strategies Design thinking is a type of problem solving. "It's a way of thinking that puts the user at the center of everything," says expert designer "Meg Dryer" "It's a human-centered approach to developing products, services, and experiences." Everyone can become a design thinker, not just graphic and product designers. This is a way to create great designs for physical or digital products to create new solutions for all professions.

"Dryer" also defined it as the process of design thinking is a deep understanding of people and their needs Gathering the problems you will solve, thinking about the concepts you will design, modeling them and then testing them over and over while getting user feedback." Design thinking includes all techniques, tools, and methods that enable the designer to develop his own business model to achieve his goals and focus on the way ideas are designed to achieve the goals. Design thinking is also characterized by being a creative method for solving problems centered around the human element to achieve the goals of any administrative process in innovative ways. Design Thinking consists of several stages, in which methods, tools and techniques are employed to find innovative solutions to a problem. It makes assumptions and redefines problems to identify alternative strategies and solutions that may not immediately emerge with our initial level of understanding.

CONCEPTUAL FRAMEWORK OF THE STUDY

1.3. The first axis:

1.3.1. The language of Inspiration and Communication with Heritage

The study seeks to provide inputs that examine the intellectual and aesthetic premises that lie in the stock of the external form of heritage arts, especially the creative and aesthetic arts, to raise the level of creativity and idea, and design artistic models characterized by originality, and enrich the language of communication between heritage and contemporary.
To be inspired by heritage through a special stylistic presentation of heritage and its elements in innovative modernist formulations that move away from the prevailing through its total images, and its presentation of elements or processes connected to each other and not as separate parts, to present it in a comprehensive form that

supports the opportunities for selection and innovation that stems from it (ABD al-Salam, Yasser Ismail (2011) . So that the issue of heritage between influence and being affected represents one of the important issues that occupy the contemporary designer, for his active role in the entity of the arts in general, and artistic designs in particular, so that heritage constitutes a necessary and essential issue for understanding the present, and proceeding from its cognitive, historical and social contexts, With the strengthening of the artistic discourse and its rooting through the civilizational background and the link of heritage with authenticity and identity, and then contemporary, To put forward innovative inputs in front of the designer to search for innovative alphabets in the relationship between the inspiration of the Arab heritage, which is synonymous with the concept of originality, (Al-Rubai, Ihsan Arsan; Al-Rashdan, Wael Munir 2003 AD).

Where the designer adapted his plastic and visual tools and vocabulary in favor of his vision towards modern and contemporary art, and cultural and popular legacies have been a source of inspiration for him since the middle of the twentieth century, because they represent the incubator of the identities of peoples and civilizations (Melhem, Rasha Abdel Fattah. 2017 AD).

1.3.2. Metallic Artifacts in Islamic Style

The flourishing of arts in Islamic periods had a great impact on the development of design thinking in the arts of artifacts, so that the mining industry became one of the most important industries. Metal products are varied as tools that are used in daily life Among the jugs, trays, bowls, holders, holders, incense burners, candlesticks, bowls, cans, utensils, vases, mirrors, and other metallic artifacts.

Where several metal strips of aluminum, copper, silver, and gold were used to craft those pieces that were covered with decorative elements such as geometric and plant motifs, as well as decorations with human and animal elements, letters and Arabic calligraphy

It is one of the most important metallic artifacts in the Islamic period One of the most famous of them is the “Tasut” which was mostly formulated using the takfit technique, and one of the oldest of these models is a piece of copper infused with silver and gold preserved in the Louvre Museum Its outer surface is decorated with a wide band of human and bird elements shaped through three circular bowls. Another brass basin preserved in the Metropolitan Museum is forged through an ornament consisting of successive horizontal bands of geometric decorations in the upper part. With several round bowls, each with delicate floral motifs.

As well as (copper jugs) enveloped in gold and silver, which were formed through two formulations, The first: a pear-shaped body with a low base and a long neck, narrow at the bottom and wide at the top It ends with a spout with a cover that connects to the top of the hull, a cylindrical inclined handle opposite on the other side of the hull a long spout. The second is through bodies with a spherical shape, a cylindrical neck, and a raised base that ends with a round ring and a handle from the top of the neck to the middle of the body.

There were also various forms of copper and bronze (trays) wrapped in gold and silver circular in shape, which were used to put food or carry pottery water, And in the British Museum there is a model of copper, infused with gold and silver, and decorated with several intertwined circular bands with geometric and plant motifs. It has naskhi calligraphy in large calligraphy interrupted by three circular bowls with vegetal decorations and naskhi calligraphy.

As well as (ceners) which the designer created many plastic formulations, some of which are cylindrical in shape that ends with a domed cover It rises above three high legs, some of which are in the form of a ball consisting of two symmetrical halves, one of which is lower representing the body of the censer and the other upper representing the lid of the censer.

And (lighting units) known as the chandelier, which was designed from hollow copper with its decoration with floral and geometric motifs and bands of Naskhi calligraphy. They represent (lanterns), (candlesticks). With multiple shapes, one of the most important lighting units made of vacuum copper, some of them were formulated with a cylindrical conical base and a high neck, and some were formulated with a cylindrical conical base topped by a high column.

This is in addition to the (cans), which are made of copper infused with silver and decorated with floral, animal and bird motifs, as well as Arabic cursive calligraphy. Large letters based on their relationships with intertwined geometric plant motifs. The manufacture of metallic artifacts was common in the early pre-Islamic periods, beginning with the Sassanid era and the Byzantine era In Egypt and Iran, the shapes of these pieces varied between trays, jugs, dishes, pots, incense burners, dallahs, and candlesticks. It was made of multiple ores such as gold, silver, copper, iron and bronze, and its components were crowned with scenes of hunting, birds, artistic inscriptions, and plants.

1.3.3. Design Formulations of Metal Tool Shapes

Censer

The incense burner is a tool from the oriental heritage, in which incense and coals are placed. Some use it through special symbols they have, the incense burners are closely related to the Arab heritage in general, and the Saudi heritage. Each region within the Kingdom Saudi Arabia, such as Riyadh, Qassim, Hail, and others, has its own distinctive designs.

Industry and Development of Design Formulations for Censer:

Censer remains one of the unique and distinctive pieces of Arab councils and homes, and the Gulf in particular, to represent the incense burner as a symbol of high taste, hospitality and appreciation of visitors to the councils, as it includes in its folds a mixture of Censer and oud wood to spread throughout the place, The Saudi house is not devoid of the "smoky" censer, which smells of Censer, after it was burned with burning embers, thus fragrant the atmosphere. The sweet scents are spread, as they are in the wedding, and the oud consoles those in the mourning councils.

And about the origin of the Censer burner in the folklore: "The Censer was an ancient vessel made of local pottery in Ras Al Khaimah. Its traditional forms were of varying size. There are many ancient Censer, some of which are wooden, made of aluminum and glass, and inlaid with colored porcelain stones. made of crystal, plated with gold or silver, or made of ornate pottery, or of metal or iron, Censer comes in the form of an inverted pyramid based on four legs. The incense burner is decorated with various decorations of copper, bronze, and glass.

Some of these censers were made of gold, silver, iron, copper, and bronze, as well as sockets of porcelain, gypsum, and pottery. Islamic censers became popular in Iraq and Yemen because of the ease of plumbing and casting and the style of its manufacture, which provided the opportunity to diversify it, such as the geometrical cubic shape with a cover, the Moroccan sphere, the shape of the dome, and with short corner legs.

Some regions in the Kingdom still maintain the censer industry, such as the city of Hail, in which care is taken to learn and transfer old industries that have been passed down for generations. Where wooden censers are made of tamarisk or hard tamarisk that grows in the desert of Hail, in carpentry workshops by digging, pruning, carving the place for placing coal and covering it with a metal alloy. Then they are decorated in different shapes, with great precision and skill. Each maker has his own style of engraving, decoration, surface treatment, and materials merging. And decorating with copper nails with blown discs and mirrors from all sides, Figure No. (1).

The Hail censer is characterized as a single piece of wood by drilling and interlacing the four columns on it with the top of the censer.

Figure No. (1) shows the methods of formulating and manufacturing the wooden censer

The Muslim designer created a number of various formulations that stray from the prevailing conventional in the forms of censer During several periods in the Islamic eras, he formulated cylindrical and spherical shapes, and what were in the shape of animals, where the bodies of cylindrical censers were covered With geometric and epigraphic vegetal motifs, then the cylindrical shape was fixed on delicate legs inspired by the legs of birds and animals, Figure No. (2).

As well as pear-shaped censers ending with crescents, which include hollow geometric shapes in a rhythmic repetition consistent with the decorations of the hoisting stands, Figure No. (3), This is in addition to the censers , in which the body is divided into two parts (fixed and movable) that allow the smoke to escape, and the designer expressed his design capabilities in designing the openings and passages for the censer smoke to exit.

Figure No. (2) A cylindrical censer with geometric and calligraphic and plant decorations, and legs inspired by the legs of birds and animals

Figure No. (3) A pear-shaped censers that ends with a crescent, which includes hollow geometric shapes

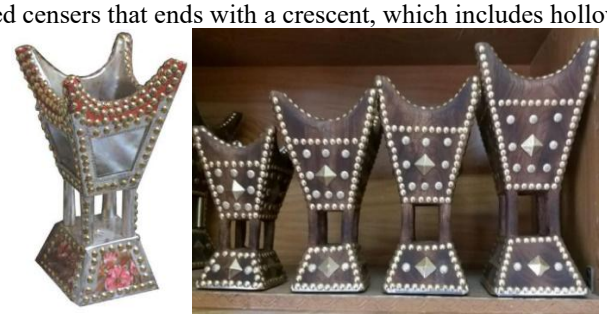

Figure No. (4) Saudi Arabian traditional censers

The sacred mosques of the Two Holy Mosques:

The supervisors of the Two Holy Mosques are keen to take great care of sanitizing the Grand Mosque and the Prophet's Mosque To perform pilgrims worship in the atmosphere of the good wind. censers with attached and carefully engraved base, made of silver or copper, are used.

Dallah

These are the pots in which coffee is placed, which the Arabs were famous for. The auctioneer in Hijaz during the Ottoman period was designed in a unified format with some differences in the decorations and the calligraphy, executed on them. The "dallah" is made of copper in Al-Ahsa, Al-Madina and Mecca, and raw copper for the manufacture of these materials is imported from India, while some other coffee dals are imported from Yemen. The manufacture of the handmade guide is known from the stamp on it, the name of its maker, and some signs such as geometric decorations and inscriptions. Among the most famous types of pampers for the manufacture of Arabic coffee are Al-Raslan, Al-Hijazi, Al-Baghdadi, Al-Qurayshi, Al-Halabi and Al-Ha'iliyah.

Perhaps the most iconic artefact in Saudi Arabia is the Dallah a pot for preparing and serving Arabian coffee. Serving coffee to guests from the Dallah is an essential part of hospitality in the Arabian Peninsula (Ball, 2017). The Dallah is an icon of the gulf region and even features on coins and banknotes and can be found in the form of large monuments on roundabouts.

The Dallah has a unique form with a bulbous shaped body, tapering into a thin waistline before flaring at the top with a long-curved spout. The Dallah can be made from different materials including steel, silver, brass, and gold. The Dallah is made from three sheets of metal, one for the main body, one for the top of the body including the spout and another for the lid (Zacharias, 2013). Often the Dallah is intricately ornamented with what can be described as Islamic art in the form of geometric designs and arabesque floral patterns Figure No. (4-B).

Figure No. (4-B) a group of contemporary Dallah

Figure (5) presents an Arabic guide within the Taif Museum collection, forged from brass in the period 13 AH / 19 AD, so that the designer combines the design and functional aspects. In order to have the design of the organic that is consistent with the function of the dallah as a tool for preserving and pouring Arabic coffee, the hull of the

dallah came through a pear shape 25 cm high to include a number of successive horizontal strips through various distances and various sizes Geometric and plant motifs, in total harmony and harmony, with six prominent copper fiestas in the form of semi-circles of equal sizes fixed at the base, and inlaid with oblique lines directed to the center of those shapes, The handle of the guide was formulated through a softness consistent with the functional aspect of the design, and a moving part attached to the cover was installed to facilitate opening and closing, and the top of the guide was decorated with three birds in harmony and visual contact that facilitated the movement of the eye through the outer line of the guide. The modified elements applied to the hull of the guide were repeated on the part connecting it to its neck, in which the welding method was used. The surface of this part is decorated with a band of contiguous circular shapes, in the middle of each of them is an isosceles triangle surrounded by a row of prominent beads, which also surround the outer surface of the circles.

Figure No. (5) An Arabic dallah made of brass (13 AH/19AD CE) preserved in Taif.

Types of Old Auctioneer According to Function and Use:
The Mutabakha: It is the one that is placed over the coals and hot water is placed in it, and it is the largest in the whole group, and it is characterized by its weight so that it can cook the coffee well and withstand the heat of the coals for a long period of time.
The filter: It is a medium-sized bucket in which coffee is fed after transferring part of the hot water to it.
The spice: It is through which spices are added to the coffee, so that cardamom and saffron are placed at the bottom and then coffee is added to it, and it is lighter in weight than the cooked pot.
The mezla: It is the bowl in which the coffee is served to the guests, and it is characterized by its small size, light weight and elegant shape.
Types of "Dallah" According to The Design Formulations:

Al-Hasawiya Dallah: As its name indicates, it is the one that was made in Al-Ahsa. It is one of the oldest pampering that was used in Saudi Arabia.	  
The Quraish Dallah: It was made in Mecca, and is attributed to the Quraish tribe. It was distinguished by its high quality and its spread in the Kingdom of Saudi Arabia, and it was manufactured from good materials and in different shapes.	 

The Hijazi Dallah: It is the one that was made in the Hijaz, and it was famous for the quality of the raw materials and the distinctive shape, so people accepted to buy it and it was known in all parts of the Kingdom of Saudi Arabia.	
Al-Dalla Al-Hailiya: It is made in Hail and characterized by high quality and accuracy in manufacture, so it is known as the most beautiful auctioneer in the Kingdom of Saudi Arabia.	
Al-Baghdadi Dallah: It is an Iraqi Dallah made in Baghdad, and its use has spread in Iraq and the Gulf region in general.	
Homsi Dallah: It is a Syrian Dallah made in Homs, and spread in Syria at first and then moved to the Kingdom of Saudi Arabia. And its price is lower than the aforementioned types of auctioneer. So it spread more and was present in every home within the kingdom.	
Dallah Al-Assaf: It is a dallah that was made in Korea of stainless steel. Therefore, Dallah Al-Assaf was known to be more practical in use, and it is not tamed, but it is replaced every period with new ones.	

The Quraish Omani dallah: It is similar to the Quraish dallah, except that its inscriptions are diverse, and it is the most widespread in the Arab Gulf states.	
Bahrain Quraish Dallah: It is distinguished by its beauty, consistency and inscriptions, and it is the only Quraish Dallah in the Gulf that is still being manufactured until now.	

Iron

The ancient Gulf Arab irons were characterized as being an iron pot, with a handle or a hand, and burning coals were placed inside it, to raise the temperature of the pot. To employ thermal ironing clothes. The iron began to be made of wood, then became of marble. Until it was made of metals, especially cast iron, because it is the most metal that heats up quickly when it meets a heat source. The flat iron, heavy, was large. The idea of the antique Arab iron made of cast iron came through good reheating in the oven or on the fire for specific periods, (Negm, Abdel Monsef Salem 2002) , Or by placing charcoal inside it by opening it from the upper moving part, and the designer has made holes in the sides of the iron to let out the heat and facilitate the ironing process, As a kind of suitability of functional aspects during design thinking, these upper and lower side slots are geometric, giving an aesthetic character to the shape of the iron And let the smoke heat out. The designer has diversified the materials and sizes of the handles from which the iron is held, so the handles are designed from raw wood in a way that is easy to hold by the hand, Figure No. (6).

Figure No. (6) The old iron made of cast iron by reheating and putting coal inside it by opening it from the upper moving part.

Candlestick lighting

The candlesticks continued their old approach, as Muslims benefited from the industries and arts of other civilizations, especially the candlesticks of the period prior to the Arab Islamic conquest.

The Fatimid figure was distinguished by its presence on a column that ends at the bottom with an arched base that stands on short legs. From above, the column ends with a crown in the shape of a pomegranate, topped by a flat circle in which candles are placed for lighting (SALEH, YASSER ISMAIL ABDEL SALAM. 2015) . The base may be in the form of convex and sometimes round and hexagonal, and the edges of the base are decorated with shapes resembling (Islamic balconies) or edges resembling hooks.

The column is cylindrical with prominent parts, most of which are in the form of a polygon in the middle, bordered by the top. It ends and below in a concave shape and protrudes in the upper side to adhere to the round disk for placing candles for lighting.

The Ayyubid Candlestick:

This candlestick was made in Mosul and Damascus with a body in the form of an imperfect cone. It is connected from above by an upper cylinder known as the hanger, and the Islamic candlesticks were of great importance. It is worth noting that the candlesticks in that period were considered among the valuable gifts exchanged by kings and sultans.

Jugs

These are the containers designated for preserving and pouring water. The Taif Regional Museum includes rich examples of these jugs. It reflects the artistic style of these metal art products used in Taif in the old days during the Ottoman period, and the current model is Figure No. (7) for a jug in the Taif region during the Ottoman period. Silver-plated red copper figures, with a total height of (35 cm), forged from a pear-shaped hull using the hammering technique, and the hull is decorated with vegetal motifs. Geometric motifs and Arabic inscriptions They are arranged in successive horizontal strips of various sizes, using the simple grooving and grooving technique in the design of the elements on the surface of the body (YASSIN, ABD AL-NASIR MUHAMMAD HASSAN .2006).

Some of these writings also include the name of the manufacturer, the date of manufacture of the jug, The artistic piece shows the designer's ability to formulate spaces that permeate geometric shapes, forming formations of lozenges and pentagons,

The sides were defined by vertical zigzag lines, and from the top these areas were identified by three parallel horizontal lines. Which holds it when the lid is lifted and the jug rests on a suitable cylindrical base. This jug is characterized by the presence of A pair of handles, one of them fixed, is used to hold it while pouring water. It has an arched shape. It is fixed from the bottom in the middle of the jug's body and from above at the upper edge of the body. The other is movable to carry the jug after filling it with water, and the two handles were fixed in two opposite positions at the edge of the neck. The outer surface of the handle is also decorated with horizontal lines at equal distances resembling the formation of the back of a snake. (Saleh, Yasser Ismail Abdel Salam. 2015 AD) The designer combined several technical stylistics in crafting the Sunday jug, such as the forging of the hull using the hammer method, and the handle, the spout, the rings, and the cover(OCHSENWALD W., "The Financial Basis of Ottoman Rule in the Hijaz, 1840□1877", 1997).

It was formulated by casting, and the decorations on the body were executed by grooving, and the jug was distinguished by the proportionality and consistency between its different parts.

Figure No. (7) a sectarian copper jug, dated 1143 AH

The designer formulated in the form of a number (8) a copper jug preserved in Jeddah, Saudi Arabia, to consist of a hemispherical base, on which a pear-shaped hull rest. With horizontal and vertical motifs distributed in harmony and consistency through floral and geometric motifs, in which the types of rhythm form the active role. Then a long crater on which the growth of these decorations continues, It ends with a dome-like lid, and on the two sides, the designer added the handle of the jug and the spout through its proportions and proportion And taking into account the body of the mass with the void and the proportion of the parts with the functional and design aspects.

Figure No. (8) a copper jug to consist of a hemispherical base, on which a pear-shaped body is based, covered with horizontal and vertical decorations

1.4. The second axis:

1.4.1. Additive Manufacturing Technologies

Additive fabrication refers to a class of manufacturing processes, in which a part is built by adding layers of material upon one another. These processes are different from subtractive processes or consolidation processes. Subtractive processes, such as milling, turning, or drilling, use carefully planned tool movements to cut away material from a workpiece to form the desired part. Consolidation processes, such as casting or molding, use custom designed tooling to solidify material into the desired shape(Singh, S. Ramakrishna, S. Singh, R. 2017)

Additive processes, on the other hand, do not require custom tooling or planned tool movements. Instead, the part is constructed directly from a digital 3D model created through Computer Aided Design (CAD) software. The 3D CAD model is converted into many thin layers and the manufacturing equipment uses this geometric data to build each layer sequentially until the part is completed. Due to this approach, additive fabrication is often referred to as layered manufacturing, direct digital manufacturing, or solid free form fabrication (Lodes et al., 2015).

The most common term for additive fabrication is rapid prototyping. The term "rapid" is used because additive processes are performed much faster than conventional manufacturing processes. The fabrication of a single part may only take a couple hours, or can take a few days depending on the part size and the process. However, processes that require custom tooling, such as a mold, to be designed and built may require several weeks. Subtractive processes, such as machining, can offer more comparable production times, but those times can increase substantially for highly complex parts. The term "prototyping" is used because these additive processes were initially used only to fabricate prototypes. However, with the improvement of additive technologies, these processes are becoming increasingly capable of high-volume production manufacturing.

1.4.2. Modern Additive Manufacturing Techniques:

This study seeks asses the viability of producing traditional copper and brass artefacts from Saudi Arabia using additive manufacturing technology. The study is based on the idea of the digital craftsman which is about bridging the gap between traditional craftsmen and digital craftsmen using digital technology to achieve traditional Saudi copper and artefacts such as cooking pots and the "Dallah" coffee pot, " iron ", " censer ". The idea that is considered in this study is whether traditional techniques and knowledge can be achieved through newly available technological techniques, specifically additive manufacturing. This idea has been informed by (Almerbati et al. 2016) who have shown that this approach is a way of preserving these traditional methods. Furthermore, it is important that in using the digital craftsmanship approach that not only are the culture and traditional preserved but also the functional features. Therefore, it is important in the production of the traditional Arab artefacts that the digital can replace the digital and that it is possible to put the traditional artefact into quantifiable parameters to carry out the digital printing (Gershenfeld, 2012).

These artefacts have their origins in cultural and functional specifications and the study endeavors to uphold these specifications in modern additive manufacturing techniques. This has been important as the traditional craft has declined in recent years and is in danger of being lost.

1.4.3. Additive Manufacturing:

Additive manufacturing, a technique that started in the 1980s, involves manufacturing objects using computers, essentially the process involves the addition of a material layer by layer to make objects instead of removal material as with earlier processes. The techniques include stereolithography, laminated-object manufacturing fused-deposit-modelling (FDM), ballistic-particle manufacturing and selective laser sintering (Kalpakjian & Schmid, 2006). It was the case that 3D printing was solely for tech-savvy engineers, however, it is now a technology available to everyone (Piore, 2013).

Although there may be the assumption that additive manufacturing technology and traditional craft are not approaches that would meet, additive manufacturing techniques are now popular, and it is capable not only of

repetition in production but also capable of the manufacture of numerous artefacts in numerous materials. Therefore, additive manufacturing is a suitable alternative for traditional techniques which are becoming increasingly obsolete.

1.4.4. Maintaining Tradition

The viability of producing traditional artefacts follows the SAFE values, specifically, the social drivers for production, Aesthetics and affordability, Functionality, and Economic and Environmental considerations (Ramirez, D., Murr, L., Li, S., Tian, Y., Martinez, E., Martinez, J., Machado, B., -Gaytan, S., Medina, F. and Wicker, R. 2011).

The feasibility of using additive manufacturing techniques would have to consider if such techniques are quicker and more cost effective than traditional methods.

Unfortunately, there has been a demise of the traditional craftsmen in the region. The traditional Arab artistic artifacts are symbolic of the region however, there is a dwindling of local traditional craftsmen, and unfortunately, the locally produced artistic artifacts have now been replaced by imports from Pakistan and Morocco (Zacharias, 2013). Using the traditional method, it takes an artisan approximately three days to complete one artifact . The process which uses many hammers and mallets of different sizes (Zacharias, 2013).

1.4.5. Viability Study

The viability study will consider both aesthetic and functional aspects of the copper artefacts as well as cultural and traditional factors. The viability study will also consider the materials and manufacturing techniques that will achieve the desired aesthetic and functional requirements.

Specifically, the functional requirements include the ability to safely hold fluids for human consumption, the ability to cook food safely and effectively and have a surface that is hygienic and easily washable. Furthermore, some of the artefacts require the safe attachment of handles.

For the aesthetic requirements, the artefacts must maintain the aesthetic qualities of the traditional copper artefacts. Artifact often intricately decorated which is achieved traditionally through the repousse technique using hammers and other tools.

In the traditional technique sheets of metal, including brass or copper are used which can easily be polished when the artifact is complete, however, there needs to be consideration of finishing techniques based on the type of finish that each type 3D additive manufacturing technique would produce.

Therefore, over all there is a need to justify the new approach to producing copper through improvement in costs and efficiency, maintenance of aesthetic and functional qualities while at the same time maintaining the traditional and cultural attributes.

1.4.6. Aesthetic qualities and manufacturing materials

Copper

A new material that is available for use in additive manufacturing is Copper (C18150) which is a chromium zirconium alloy that has good electrical and thermal conductivity (Anon, 2019). The viability study is concerned with both the idea that copper artefacts can be made for aesthetic purposes or practical purposes. With Copper (C18150) sophisticate parts can be printed using this material which includes heat pipes and cooling structures within rockets due to its thermal conductivity qualities (Anon, 2019). Furthermore, this material is stable up to 700 degrees Fahrenheit. Important attributes that are offered by copper also include heat conduction and for cooking utensils (Anon, 2019 B). It is important to note that copper is a dense material, so the completed printed artefact represents only a third of the volume of copper filament.

Copper is a material that has high thermal and electrical conductivity and when this is combined with the possibilities or freedom that is provided by additive manufacturing there is a promising future for applications looks at the fabrication of Cu (Copper) components using additive manufacturing, specifically, electron beam melting (EBM).

identify several different additive manufacturing techniques that use metal powders for the manufacture of functional and non-functional prototypes, these metals include copper. Despite the numerous disadvantages in terms of surface roughness, fatigue and tensile strength, advances have been made in the production of metal powders. Copper powder is produced using electrolytic processes to improve their properties (Singh et al., 2017). Surface roughness is an issue in additive manufacturing using metal powders, this may be due to non-flat layer edges or layer roughness, or may be due to surface qualities however, this can be resolved through machining out or using smaller layers.

Brass

Brass is an alloy of copper and zinc and is commonly used in the 3D printing of jewellery for several reasons. The advantages of using brass include versatility, detailing, finishing, shine and cost (Aura, 2018). The present feasibility study is concerned with the production of traditional Saudi Arabian copper and brass artefacts using 3D

printing techniques and one of the important attributes of the traditional items is the finish. Using brass in 3D printing does allow several different finishes to be obtained which include untreated, PU coating to protect from scratches and oxidation, gold plating, red gold plating (the same colour as pink gold), black colour plating, chrome plating and rhodium plating. These finish options are particularly advantageous as the traditional artefacts often include two-tone designs. Furthermore, brass is one of the most affordable metals for use in 3D printing.

1.5. Selective Laser Sintering

SLS is a form of 3D printing uses lasers to heat and fuse metal powder to produce components. Although this approach is relatively old it has been used more recently to produce functioning complex metal taps.
The 3D printing techniques for this material include Direct Metal Laser Sintering (DMLS) and Desktop Metal as one of the metals offered by its system, which is a much cheaper alternative than the laser printing techniques, (Anon, 2019).

1.5.1. Technologies:

There are several different 3D metal printers that are now available on the market that are considered for viability for this project. The area of 3D metal printing is not entirely available to the consumer at the present time, however, technology that was previously on a large industrial scale and was very expensive is now becoming more available for small to medium sized enterprises. The viability of printing traditional copper or brass artefacts not only depends on the need to maintain the traditional craftsmanship, but also the availability of 3D printers that are suitable for small to medium manufacturers.

1.5.2. HP Metal Jet

The HP Metal Jet can produce a high volume of production grade items. The print volume is 430 x 320 x 200 mm. Unfortunately, this technology has been designed for large scale industry and simply would not be cost effective at the present time, however, by 2021 the printer will be more available commercially at a cost of $399,000 (Griffiths, 2018). Despite this, the HP Metal Jet is designed for mass production and any consideration for its investment must be determined against potential commercial quantities.

1.5.3. Desktop Metal

The Desktop Metal, which includes the Studio System and the Production System as much more affordable options. The Studio System is desktop-sized that uses the Bound Metal Deposition (BMD) process. The process involves the use of polymers which are bound to MIM metal powders, upon completion of the printing the part placed in a furnace and the polymer is melted away leaving the metal product. Alternatively, this company offers the Production System, this is more suitable for industrial use and uses single pass jetting which uses 32,000 jets to spray millions of droplets per second. Although these two systems are too expensive for the consumer, they are considerably cheaper than other technologies and are feasible for copper artefact manufacturers in Saudi Arabia.
The process that is used by the Desktop Metal Studio involves three stages, namely, the printing, rebinding, and sintering in a furnace. These processes are more easily understood against the material composition of the printed part. The material used in this system for several metal alloys comprises of metal alloys with wax and a polymer binder. The first part of the process involves heating this material and extruding the part layer by layer which is a process like an MFDM printer. The printed part is then placed in decider for rebinding where the primary binder is removed, this point an open pore structure is created ready for sintering in the next stage. During sintering the remaining binder is removed and the metal particles are fused together, and the resulting part is densified from between 96 and 99.8 percent (Proto2000, 2018, Anon, 2019 B).
The Desktop Metal Studio offers Copper as one of its materials which is described as a high purity copper (Anon, 2019 B). Other materials that are offered by the Desktop Metal Studio include Alloy 625, H13 Tool Steel, and stainless steel. Alloy 625 is suitable for extreme environment applications and rapid temperature change, even for use in nuclear reactors and H13 Tool Steel is resistant to thermal cracking, however, for these specialised metals there needs to be cost considerations. As a more cost-effective alternative, stainless steel has been described by the Desktop Metal organisation as being suitable for use in high and low temperatures, is corrosion resistant and suitable for food processing .

1.5.4. Markforged Metal X

Markforged is a 3D printer that is more accessible to the consumer market. The Markforged Metal X is the most affordable 3D metal printer and offers a build size of 250 x 220 x 200 mm. This printer can print in stainless steel and copper. Importantly, this printer is affordable, and it is capable of building complex parts. One noticeable advantage of the Metal X is the cost savings with well over 90 percent cost savings compared to machined parts, however, this saving is against precision machined parts and savings against the current process for producing the artifact need to be determined. Overall, the Metal X is reliable, affordable, and easy to use.

1.5.5. LENS

Optomec offer the range of LENS 3D metal printers which are cost effective and suitable for manufacturing high performance metal in materials which include stainless steel and alloys. The process involves using a laser to build layers from a metal powder material. This printer offers excellent mechanical properties, rapid design changes and is suitable for low volume manufacturing if required, furthermore, the entry level machine is $250,000(Locker, 2019).

CONCLUSION AND RECOMMENDATIONS

1.6. First, the Conclusion of the study

In conclusion this study has explored the viability of using 3D additive manufacturing techniques to produce the traditional artifacts. The viability of techniques included consideration of maintaining the traditional craft through the concept of a digital craftsman. The need to maintain traditional craft has come about because of a decline of such practices in the region. The digital craftsman approach is a necessity to preserving traditional artefacts through a digital process that is informed by traditional craftsmanship. This research has highlighted the viability of such an approach and the variables that are involved which in future research can be used to look at the viability of preserving other regional crafts in the same way. The study has revealed the importance of factors for viability which not only include techniques but also cost and scale considerations.

1.7. Second: Study recommendations

-Conducting more qualitative and specialized research that is concerned with studying and analyzing the feasibility of modern 3D additive manufacturing techniques to enrich design thinking.

- Conducting more research on studying and analyzing traditional Arab and Gulf handicrafts and drawing inspiration from their values in designing and formulating products that keep pace with the spirit of the age and the development of its techniques.

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