Ancient Artifacts: An Investigation about Designers' Solutions for Tackling Similar Problems in Neighboring Civilizations in a Same Period of Time

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Abstract

Comparing artifacts or products of civilizations to each other shows that how diverse historical nations made different decisions when confronted with the same challenges. This paper aims to investigate designers' solutions for tackling similar problems in neighboring civilizations, Helmand (Shahr-i-Sokhta) and Indus valley (Mohenjo-Daro), in a Same Period of Time. Research methods have been developed through the study in two steps. initially, after studying all the discovered seals from two civilizations, based on research hypothesis, comparing factors were defined based on three main product design dimensions (functional, aesthetic, symbolic), and 4 seals of each civilization were selected. Afterward, the similarity of Shahr-i-Sokhta and Mohenjo-Daro's seals was evaluated via a sample group, including 34 Iranian industrial designers, as participants with a DbA (Design-by-Analogy) questionnaire. The results show that in the considered period in both civilizations, the design focused on the form, aesthetic, and the symbolic aspects more than the engineering considerations.

Keywords

Comparative Design Studies, Design by Analogy, Ancient Artifacts, Design Solution, Ancient Civilization.

Introduction

Comparing civilizations to each other and drawing out the similarities and differences among them invites us to think about how various historical groups, from time to time made different decisions when confronted with the same challenges (Aldrete, 2011). Artifacts always have been a main portion of each civilization to study since they are objects that have been made intentionally, in order to accomplish some purposes based on Aristotle's explanation, artifacts that exist by craft have their origin in the craftsperson—specifically, in the form of the thing as it exists in the mind of the maker (Preston, 2022). Thus, artifacts or products could be good exemplars for comparing civilizations because they have shown the needs of a society and also the ways and processes of fulfilling demands by artifacts through designers' or makers' minds. Several studies have been conducted in the field of ancient civilizations, but the main focus of them is based on archaeological studies (Mosher, 2017), architecture, and urban structure of historical civilizations (Kiani et al., 2014; Mohamadkhani, 2015), and cultural studies and relations between two civilization (Daliran & Oveisi, 2023; Ascalone, 2006).

Also, the analyses performed on the discovered objects were from the archeology, aesthetics, and semiotics point of view, not from the design point of view. Among the few comparative studies that have been done on the discovered objects from two ancient civilizations, can refer to the Hashemi Nia (2018) that described possible commercial and economic exchanges between the two civilizations by investigating the patterns on the pottery. Thus, studying the design literature has shown that there is less consideration of comparative design studies among Iranian industrial designers while these studies might empower them in different stages of the design process such as ideation or implementation. The emphasis of this paper is on investigating this issue from the design point of view and the importance of how former designers respond to the common needs for designing and making functional objects and artifacts in different ancient civilizations.

Since we are likely to confront the same problems or demands like people who are living in another places, comparative design studies could be considered as a significant clue for solving problems in many disciplines, and product design is not an exception to this fact. Hence, the authors believe that studying and examining ancient civilizations from the perspective of product design as a case study has remarkable plus points for designers such as gaining ideas, studying production processes, and learning about used materials to name a few. The research then addressed the mentioned gap through below research question: Do designers provide the same design solutions for a design problem in distinct places?

To answer the research question, we hypothesized that the design solutions generated by different designers in different places have similarities. Therefore, the presented research aims to demonstrate the importance of considering comparative design studies by investigating the possibility of the likelihood between designers' Solutions for tackling the same problems in Neighboring Civilizations in a Same Period of Time. The assumption of authors is that there are some similarities between designed products for the same need in two neighboring civilizations in the same period of time. Therefore, the assumption has been examined by studying seals as important products of two ancient civilizations, Shahr-i-Sokhta and Mohenjo-Daro, as a solution for identical needs in the simultaneous period in order to indicate whether there are any likenesses between them or not.

Importance of Studying Iran and India

Shahr-i-Sokhta, as the largest urban settlement in the Iranian plateau, is a unique example that due to its special climatic, political, and cultural location, has been considered the center of communication between the great civilizations beyond Mesopotamia, India, and China (Miri, 2015). Shahr-i-Sokhta was a large commercial and trading center on the plateau of Iran and its communication route was through the Silk Road for the exchange of goods, etc., so it can be said that cultures such as that culture of the Indian subcontinent have a great impact on life and community of the Shahr-i-Sokhta.

This influence has been taken more from the Harappan and Mohenjo-Daro civilizations (Hashemi Nia, 2018). This city is currently the most valuable and largest symbol of civilizations in the Sistan plain. The study of ancient artifacts and materials is not limited to the evolution of science but by studying and examining the remains of various cultural materials and observing the techniques of the Iranian plateau and the relationship of this civilization with other civilizations around it, such as India (Sajjadi, 2005).

The trade connection of the Shahr-i-Sokhta with Central Asia, led to create many similarities in artworks of these two regions, especially in the clay statues of humans and animals and in their seals and motifs which are of the eastern flat seals type. In addition to this connection through trade and commerce also between the Shahr-i-Sokhta with others. Therefore, over time, the impact of these two civilizations can be seen from the remnants of their historical sites, which include tablets, pottery, metals, stone tools, etc (Sajjadi, 2005). Since Iran played an important role between East and the West as a bridge in ancient time, the significant contribution of Iran in the world civilization is completely obvious and at the same time, Western India (or present Pakistan) was an area which definitely contributed to the world civilization and culture (Tavassoli et al., 2011).

Literature Review

1. *Theoretical Background*

Mohenjo-Daro

Mohenjo-Daro, an important city of the Indus civilization, is an archaeological site in Pakistan that has remained as a significant site for archaeologists and other scholars to explore (Gohar et al., 2021). The exploration of Harappa and Mohenjo-Daro in the 1920s and resultant recognition of the widespread Bronze Age culture, so transformed the developmental narrative of world history and South Asia is now considered amongst the earliest locals for the emergence of complex society globally (Mosher, 2017). The sites of the Sindhi-Harappan civilization are divided into two main and northern groups, namely Punjab, whose main city is Harappa, and the southern group of Sindhi, whose main center is Mohenjo-Daro (Sajjadi, 2019). It is one of the 1500 other sites within the Indus River valley which is located on the right bank of the lower Indus River in Larkana District, Sindh, Pakistan. Harappa and Mohenjo-Daro are the two most important ancient cities discovered by archaeologists in the Indus Valley in what is today Pakistan and northeast India. Mohenjo-Daro was one of the series of settlements known as the Indus Valley Civilization. Named after the Indus River, this early civilization covered vast areas of what is now Pakistan and northwestern India, with an estimated population of 40,000. Mohenjo-Daro was a well-planned settlement with efficient urban facilities such as street drainage, sewers, and extensive civic buildings. Residents also had access to well water, and large number of them had baths at home (Brewminate, 2020).

Shahr-I- Sokhta/ Burnt City

Sistan plain is located in the southeast of Iran. Merits such as geographical location, altitude, soil type, topographic conditions, and access to the Helmand water network are the most important factors in the formation of the first rural and human settlements in this region. In days gone by, Sistan has been one of the centers of culture and civilization in eastern Iran (Mahmoodi & Ghasemi, 2021). Shahr-i-Sokhta is located on the right side of Zabol-Zahedan road and includes a series of attached hills which are 56 km far from Zabol city (Falaki & Mehrafarin, 2020). It is more than 5,000 years old and is one of the most important sites of the Bronze Age in the east of Iran and was occupied from 3200 until 1900 BC. The Shahr-i-Sokhta was first identified in 1916 by Aurel Stein (Ameri, 2020). She said that from 1967 to 1978, the site was excavated by the Italian Archaeological Mission in Iran and again by an Iranian team with the leadership of Seyyed Mansur Sajjadi beginning in 1997. Shahr-i-Sokhta had extensive business relationships with other contemporary civilizations in Central Asia, the Indus plains, and the western part of the Iranian plateau (Mohammadkhani, 2015).

2. *Seals and Seal Functions*

Seals are significant cultural relics which can teach us more than other ancient objects about diverse aspects of mysterious civilizations and cultures of the former times (Falaki & Mehrafarin, 2020). A seal is a small object made from different materials such as stone, wood, ivory, bone, or clay (Beuthe, 2016) which is generally used to render an impressed image on a secondary soft surface. Seals show engraved motifs and are generally perforated, thus they can be suspended. Different pictures, writing, or a mix of them were carved on the surface of seals, and they were used from circa the 7th millennium BCE onward (Beuthe, 2016). Generally, seals are divided into two categories cylindrical and flat (stamp) based on their effect upon the secondary surface (Falaki & Mehrafarin, 2020) as well as they have been categorized based on their motifs or impressions into two groups, seals with single motif and seals with multiple motifs (Hessari, 2019). They consisted of patterns such as plants, geometrical shapes, human and animal figures, or a mix of them either realistic or abstract. Meanwhile, the main function of a seal is to stamp off a picture, pattern, writing, or mix of them on another material (Kenoyer, 2006); however, other functions have been mentioned in different resources.

In explaining the function of seals, take for instance in the Indus valley, seals were used as a tool of control in trade or administration (Shah et al., 1991). Moore and Reid (2008) said that the seal's function was to indicate the identity or authority of the sender of a commodity or goods, which was allocated by an individual or governmental department to a particular person who carried the seal impression. Also, Pittman (2018) explained the administrative role of seals in Mesopotamia and Iran plateau in the Bronze Age and claimed that seals were applied for controlling commodities for distribution, as well as for impressing tablets or documents. By the same token, seal imagery is used to convey complex meanings which were referred to the controlled object or subject (textiles or Foods) or identify the controlling authority. On the website of Heidelberg University in the section of philosophy faculty, it is clarified that seals are functional objects and three main functions can be attributed to them: securing, marking, and authorizing. It could be understood that the fundamental notion of sealing systems, is implicitly associated with personal, corporate, or administrational identity (Denham, 2013). Eventually, in consideration of the former studies, functions of the seals have been classified by authors in order to obviously indicate ancient people's invisible demands seen behind this artifact (Table 1).

Table 1: *Functions of the seals.*

Used by	Functions		
	Securing/Controlling	**Identifying**	**Authorizing**
Individual	Seals would have been impressed on clay lumps placed on an object in a way that if someone wanted to use it the stamped lumps must have been broken.	Seals which directly stamped on objects, or stamped clay lumps that hung with a string from an object.	To prove authorization for certain dealings, services or commodities, or even as receipts, in these cases seals were impressed on free clay lumps and used like a token.
Governmental /Corporative			
	Explanation: In all functions, seals present some information such as their creator, owner, contents etc.		

3. *Mohenjo-Daro's Seals*

In the Sindhi civilization, seals were used to seal commercial goods, pottery, and other objects. On the other hand, their standardization, the use of specific criteria for weighing and measuring goods, indicate the rule of law and the controlling political system (Sajjadi, 2019). Materials used to make seals include clay, gold, semi-precious and precious stones, copper, ivory, and glass (Brewminate, 2020). These small objects have been beautifully carved out of stone and then fired to make them more fortified and durable. Over 3,500 seals have been found so far. The most typical Indus seal is square, with a set of symbols along the top, an animal in the center, and one or more symbols at the bottom. Animals which were found on the seals include rhinoceros, elephants, unicorns, and bulls.

Ancient Artifacts: An Investigation about Designers' Solutions for Tackling Similar Problems in Neighboring Civilizations in a Same Period of Time

JDT, Vol. 4, No. 2, December 2023 | 310

It is worthwhile to mention that on the back of seals there is a projection, probably to make the application of seals easier while pressing them into other materials such as clay to create pattern. In addition, the protrusions have a hole for a thread to be crossed, presumably to allow the seals to be worn or used as a necklace. Each seal is engraved in a pictographic script that has yet to be deciphered. They all carry a variety of motifs. The symbols at the top of the seals are generally thought to form the script of the Indus Valley language (Brewminate, 2020).

4. *Shahr-i-Sokhta Seals*

Seals and the effect of various seals have been obtained from the historical sites of the Third Millennium BC (2020) in the southeastern region of Iran, one of the most significant of which is the Shahr-i-Sokhta of Sistan (Ascalone, 2006). One of the most characteristic elements of the state of change and continuity and cultural sequence of the Shahr-i-Sokhta are their seals and works (Tosi, 1983). From the total of 220 burials excavated in the first round, 33 seals were obtained in the Shahr-i-Sokhta. Most of the seals obtained from the Shahr-i-Sokhta are flat seals that have been made of stone, especially soapstone (Sajjadi, 2005). Patterns which were designed on the seals depended on the types of the seals, and considering that not all the raw materials for making seals were available in the place itself, so according to the needs of these materials, they were brought from other areas where could be considered as an evidence of trans-regional trade. On hard seals, geometric and rudimentary patterns are cracked. Animal motifs include bird motifs such as hubris, ducks, and eagles, which are depicted in different styles, and sometimes animals such as lions, snakes, and deer are engraved on seals (Sajjadi, 2005).

Methodology

The present study is of a deductive mixing method type that created links between qualitative and quantitative issues. The aim of this research was to investigate Designers' point of view and their priorities to solve a similar need (seals), in two civilizations Helmand (Shahr-i-Sokhta) and Indus Valley (Mohenjo-Daro) in the same historical time period (Bronze Age). Hence, it was necessary to identify which aspects of the product were more important for the designer; therefore, first of all, we define comparing factors based on three main product design dimensions: functional design, aesthetic design, and symbolic design (Candi et al., 2017). At the first stage, after studying all the seals discovered from two civilizations, Shahr-i-Sokhta and Mohenjo-Daro, using library resources, based on research hypothesis and questions, the case study was identified based on selecting four important seals of each civilization (three in flat and one in cylindrical form) and authors considered each couple of selected seals from two civilization similar to each other (for example seal number one from Shahr-i-Sokhta similar to seal number one from Mohenjo-Daro, Table 2). The reason for selecting these 8 seals was their similarities in form, design, and symbolic icons from each other.

Participants

Although the number of sample participants should be identified based on the number of the target population, we selected 34 Iranian industrial designers (men and women) to consider the minimum number of participants (n=30) required to ensure the accuracy of the relationships (similarities) between solutions (Tuckman & Harper, 2012). Also, four extra participants were recruited to enable the authors to purify the data for better quality.

The purpose of recruiting industrial designers as participants in this study was to understand whether they could distinguish similarities between ancient designers' solutions (seals) from different civilizations. Meanwhile, the participants were chosen by convenience sampling (non-probability sampling) through an invitation to social network groups of Iranian industrial designers.

Table 2: *Similar seals, were selected from each civilization.*

Selected Shahr-i-Sokhta Seals	
No 1: Seal no.: 1605/17 Seal material: copper/bronze Seal shape: bird-shaped Design: Figural- bird-shaped	
No 2: Seal no.: G712/24, inv. 7645 Seal material: copper/bronze Seal shape: stepped cross Design: Stepped cross with internal stepped triangle.	
No 3: Seal no.: 1505/16 Seal material: stone-alabaster Seal shape: square Design: Cross in square	
No 4: Seal no.: G738 Inf./7 Inv. 8497 Seal material: stone- limestone Seal shape: cylinder Design: Geometric- zigzag lines	
Selected Mohenjo-Daro seals	
No 1: Seal no.: Mohenjo-Daro, HR 743 Seal material: white fired glazed steatite Seal shape: square/ flat Design: animal-unicorn+ eight symbols run along the top of the seal	
No 2: Seal no.: Mohenjo-Daro, DK 12050 Seal material: tan steatite. Seal shape: square/ flat. Design: anthropomorphic- a nude male deity with three faces, seated in a yogic position on a throne+ Five symbols of the Indus script.	
No 3: Seal no.: Mohenjo-Daro, DK 0416.8 Seal material: steatite Seal shape: square/ flat Design: No iconography- abstract, The *Swastika* symbol, geometric shapes.	
No 4: Seal no.: Mohenjo-Daro, DK 5567 Seal material: fired white glazed steatite Seal shape: cylindrical Design: Long rectangular seals with Indus script	
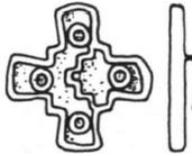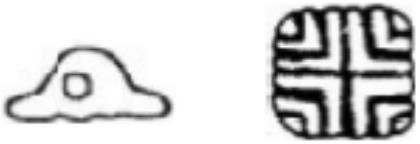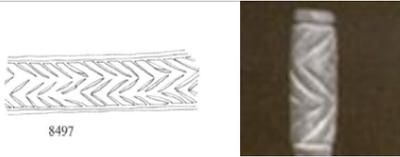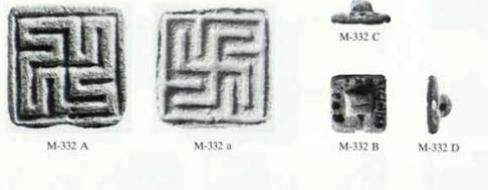
Ancient Artifacts: An Investigation about Designers' Solutions for Tackling Similar Problems in Neighboring Civilizations in a Same Period of Time

JDT, Vol. 4, No. 2, December 2023 | 312

Data Collecting

A questionnaire was created in Google Form, and initially five design experts, as a pilot group, have answered the questionnaire in order to control whether the questionnaire is meaningful or not. Then, the link of questionnaire was sent to the participants on WhatsApp and Telegram. Before answering the questionnaire, participants were reassured that their information would remain confidential, and they were free to answer questions. Also, with this method, users in different cities of Iran were able to answer the DbA questions.

Design-by-Analogy (DbA) Questionnaire

Design by Analogy (DbA) is a design methodology in which new solutions, possibilities, or designs are generated in a target domain based on inspirations from a source domain. It can benefit designers in mitigating design fixation and improving design ideation outcomes (Jiang et al., 2021). A DbA questionnaire was developed according to the standard of other DbA questionnaires. The online-collected questionnaire data went on analyzing the similarity of Shahr-i-Sokhta and Mohenjo-Daro seals. In this study, we designed four questions based on five independent variables (Table 3).

Table 3: *Independent variable of questionnaire.*

Independent Variables	Description
Function	Securing/controlling, identifying, authorizing
Usability and Ergonomics	Easy to use, adapting with anthropometry
Material	Copper/bronze, stone, steatite, clay
Symbol or Sign	Animal motif, anthropomorphic, no iconography
Form and Shape	Flat, cylindrical, geometric

In each question, an image of one of the Shahr-i-Sokhta seals was shown as the target product, and four seals of Mohenjo-Daro seals were placed as source products in the options. At the first stage, the participants were asked to choose two options from the source seals that are most similar to the target seal, and then choose the reasons for this similarity from among the specified factors.

Table 4: *The most similar seals among the resource seals to the target seals based on DbA questionnaires.*

Question	Target Seals	Source Seals	Function	Usability	Material	Symbol/Sign	Form & Shape
1			15	5	0	15	26
2			14	9	3	10	20
3			17	4	3	14	23
4			13	3	4	12	16

Data Processing

After collecting data from questionnaires, the data has been analyzed. Initially, demographic data has been extracted, and afterward, the number of selecting each source seal as a similar option to the target seal and the number of choosing significant design factors as a reason of similarity between the selected source and target seal have been elicited (Table 4). In this table, based on the rating of users to the seals, it has been indicated the most similar seals among the resource seals to the target seals in each question, and the number of factors for each of the effective factors in the design is displayed separately. Eventually, based on analyzed data the findings have been demonstrated which will be shown in the result section.

Results

The total results obtained from the questionnaires, indicated that the number of effective participants reached 30 (21 female and 9 male) by eliminating the responses of four subjects due to the selection of conflicting options with the help of software techniques (Table 5).

Table 5: *Demographic information of participants.*

Demographic Categories	Frequency	Valid percentage
Gender		
Male	11	30
Female	23	70
Age (year)		
21-30	20	52.9
31-40	14	35.2

Examining the questionnaires also shows that the greatest similarities can be found between seal number 1 of Shahr-i-Sokhta seals with seal number 1 of Mohenjo-Daro seals, seals number 2 and 3 of Shahr-i-Sokhta seals with Mohenjo-Daro seal number 3, seal number 4 of Shahr-i-Sokhta seals with Mohenjo-Daro seal number 4, while seal number 2 of Mohenjo-Daro was not selected among the options with the most similarity. Also, the numbers of effective factors in design which were selected as the reason for the similarity between the two seals, in each question made a trend line for the similarity of seals. The trend line of each question is shown in a comparative way (Figure 1). It shows the similarity of the answering process and the number of selected design factors in each of the four questions. Also shows the most and least selected factors as the similarity between the two seals.
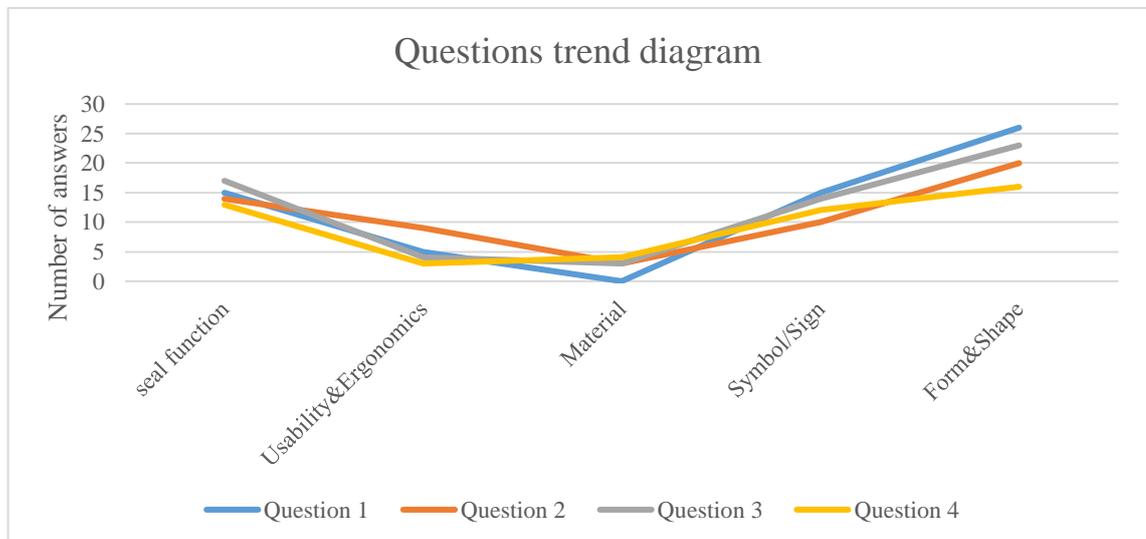

Figure 1: *Trend diagram for all DbA questions.*

Another finding obtained from the extracted information is the three design factors with the highest number of choices as the main reasons for the similarity between all the chosen seals by the respondents of the questionnaires (Figure 2). These three factors are form, symbol or sign, and function, respectively.
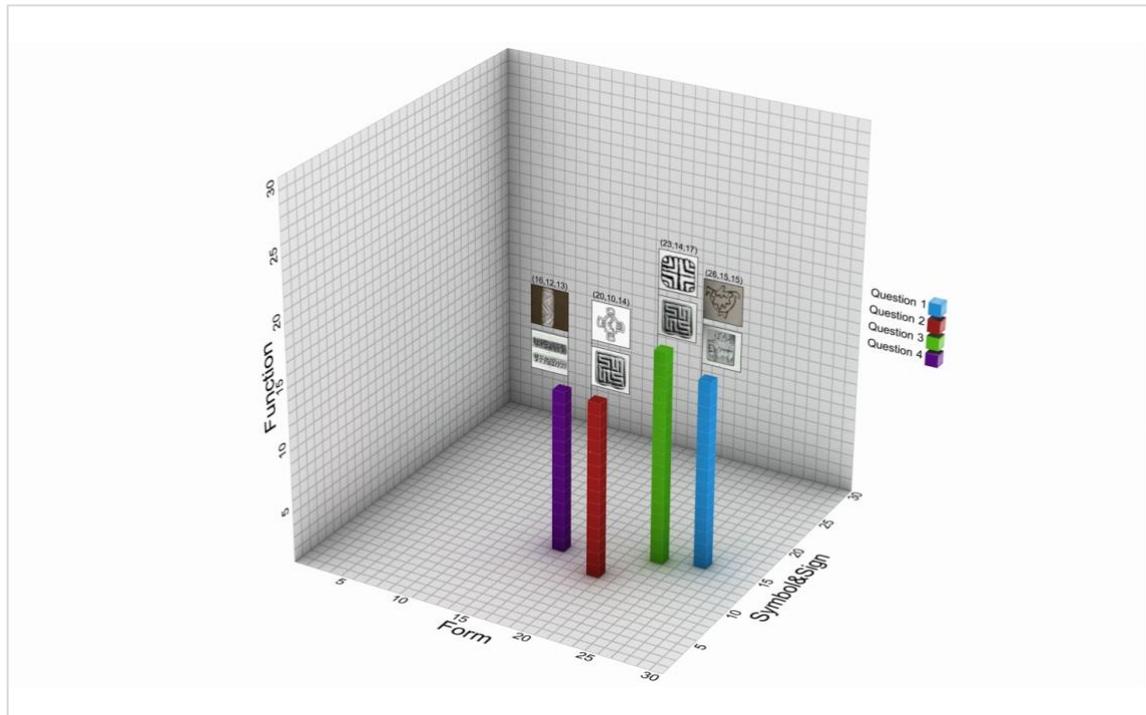

Figure 2: *Three-dimensional diagram of the main design factors in creating similarity.*

Discussion

This research remains relevant to modern design studies, particularly in the area of Design-by-Analogy (DbA) and cross-cultural design. By applying a comparative approach to ancient artifacts, this study shows how designers can learn from historical precedents when faced with similar problems. This approach can be applied to modern challenges in product design, where designers often need to draw inspiration from diverse cultural and historical contexts. Furthermore, understanding how ancient civilizations approached design challenges can inspire innovative solutions for contemporary problems, especially in fields such as industrial design, architecture, and cultural product development.

It seems necessary to pay attention to the fact that the product examined in this research was commercial seals, and of course, this study cannot be generalized to the designers' point of view in other products, and each product should be examined separately and focused. The most important difference between this study and others is that in this research, an attempt has been made to examine this issue from the point of view of product designers (industrial designers), while in previous studies, the point of view of archaeologists has generally been discussed, and no similar study has been done so far.

One of the limitations of this research was that due to the selection of the historical period (Bronze Age), it was not possible to have accurate access to the designers and understand their views, and we tried to consider a suitable method to create a product. Similarities in two civilizations should be investigated by contemporary designers and the research question should be answered based on the analysis of these design viewpoints, while the impact of different cultural, security, economic conditions, etc. at that time on the design cannot be considered. In other words, it can be said that this research was done only from the point of view of design factors without considering the environmental conditions and life of designers.

Another limitation in this design is the limited resources and the few remaining images of the seals of both civilizations, and naturally, it was not possible to access the products in a physical and tangible way, and the evaluation of the participating designers in this research was done through the photos of the products while there are definitely remaining factors, such as usability and ergonomics which can be evaluated better if the real product can be accessed. With the help of such research, the importance of paying attention to comparative studies with a multifaceted approach (among civilizations, common needs, and common periods) can be highlighted for product designers, and the results can be used to reach creative solutions in various stages of design. Also, this research can be the beginning of further studies regarding the investigation of this hypothesis or similar hypotheses related to a wider range of products and common needs, or newer periods.

Conclusion

The obtained results in this research demonstrated that the most similarities between seals in two regions were in form and function. In terms of form, the seals of both regions followed two general patterns of flat and cylindrical seals. According to the findings, the primary and main function of the seals of both regions (marking commercial goods) has been assessed to be similar, due to the geographical location of both civilizations and their importance as the main poles of the Indus Valley and Helmand civilizations, the cultural commonalities and influence of the two regions is remarkable. In terms of ergonomic considerations and the way of making, all the seals are evaluated as simple and free of any complexity, which shows the limitation in the construction and technology in the desired time frame.

In general, it seems that in the considered time period in both civilizations, the design of the form, aesthetic, and symbolic aspects have been given more attention than the engineering considerations. Also, the study offers a deeper understanding of how design functioned as a medium of cultural expression and communication in ancient societies. The similarity in seal design between two geographically and culturally linked civilizations suggests a degree of cultural exchange and shared priorities, possibly influenced by trade routes like the Silk Road. This reflects the importance of design in facilitating not only commercial transactions but also cultural interaction, which enriches our understanding of the historical significance of artifacts as tools for social and economic exchange.

In addition, we can point out two different design points of view between the seals of the two regions. Firstly, the human motifs associated with Indian gods in the seals of Mohenjo-Daro, where no traces of human motifs can be seen in Shahr-i-Sokhta, and secondly, the variety and number of geometric motifs (abstract) in the seals of Shahr-i-Sokhta was much higher than that in Mohenjo-Daro.

The findings of this research can provide valuable insights for contemporary designers by illustrating how ancient designers tackled common design problems with limited technological resources. The emphasis on form, aesthetic, and symbolic dimensions in both civilizations, despite their distinct cultural contexts, shows that designers tend to prioritize the communication of meaning and identity through design. This can inform modern product designers about the importance of cultural relevance and symbolic messaging in design practices today. Moreover, the study demonstrates the role of trade and cultural exchange in shaping design trends, which is still highly relevant in today's globalized design landscape.

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Ancient Artifacts: An Investigation about Designers' Solutions for Tackling Similar Problems in Neighboring Civilizations in a Same Period of Time

JDT, Vol. 4, No. 2, December 2023 | 318