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TRANSFORMING CITIES THROUGH HERITAGE: A DECISION-MAKING TOOL TO IDENTIFY AND LEVERAGE CULTURAL ASSETS IN THE BAY OF ALGIERS

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Abstract: Heritage plays a pivotal role in strengthening the tourism sector and, by extension, in contributing to the economic vitality of cities. This study evaluates the heritage value of municipalities within the Bay of Algiers by applying a decision-making framework grounded in Multi-Attribute Value Theory (MAVT). The research develops and operationalizes a systematic tool to measure heritage value, classifies the municipalities according to their respective scores, showing that only three of the nine municipalities achieved a positive rating, and identifies key barriers that limit the effective valorization of heritage resources. The robustness of the results was verified through a comprehensive validation process. A high consensus rate among experts (87.2%) confirms the reliability of the assessment. The low Consistency Ratio (CR = 0.4%) and Global Consistency Index (GCI = 0.02) demonstrate methodological soundness, while sensitivity and robustness analyses further emphasize the stability of the Analytic Hierarchy Process (AHP) model applied. Statistical validation, including a 95% confidence interval (0.056–0.352) and a standard error of 0.075, strengthens the credibility of the findings. The outcomes of this research not only highlight municipalities with significant heritage potential but also provide critical insights for policymakers. By adopting proactive and evidence-based strategies, public authorities can safeguard, enhance, and transform these cultural assets into globally competitive tourism destinations, thereby reinforcing sustainable urban development.

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Keywords: Heritage; MAVT; Assessment; tangible; intangible; decision-making tool

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INTRODUCTION

Tourism is a driving force of the economy; it is seen as a direct effect of the conservation and enhancement of heritage. Thus it is generally represented as a link between historical and cultural heritage and the economy (Rypkema & Cheong, 2011). Indeed, heritage plays a great role in influencing the tourist destination, so its impact on tourism can be seen through the number of employees working in this field, the number of visitors, duration of visit and means of transportation, etc. Thus, the present study leads the choice of the best performing municipality according to heritage value to be reused in reinforcing identity and tourist destination of the city.

Nine municipalities of Algiers Bay were compared using a set of indicators divided into tangible and intangible. The evaluation of the heritage value using the multi attribute value theory plays an important role in determining the model to be applied in order to evaluate heritage value and classify municipalities of Algiers Bay according to it.

The application of the methodology for evaluating heritage value using various indicators was first practiced in the 1990s (Silvio Mendes Zancheti & Hidaka, 2011), it dates back to 1999.

The relevance of this operation lies on the involvement of several disciplines, be they cultural, economic, social, or ecological and political, etc. however, the introduction of these disciplines makes the decision-making process more important and complicated at the same time.

METHOD AND MATERIALS

Case of study

Algiers is the capital of Algeria in terms of politics, business, and government. It is a seaside metropolis with 3,154,791 inhabitants, making it Algeria's most populous city (DPAT, 2015). The bay of Algiers is comprised of nine municipalities, collectively spanning 54.43 km^2 (Figure 3-3), and each has a unique surface area and population. With over 574880 residents, it makes up 6.73% of the Algiers region and 18.22% of the capital's population.

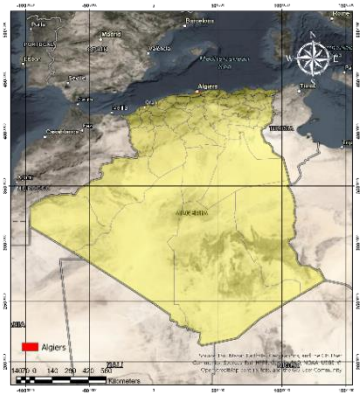

Figure 1. Location of the wilaya of Algiers

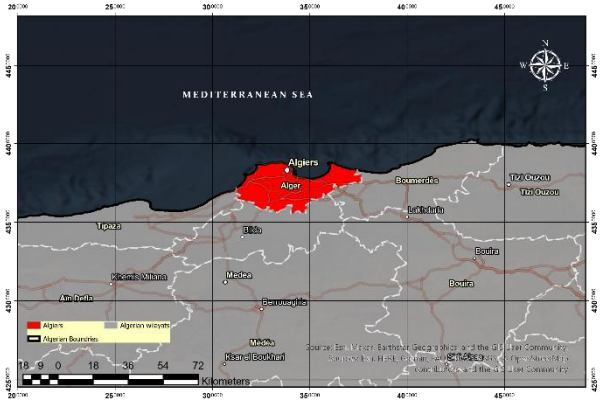

Figure 2. Location of the wilaya of Algiers (different perspective)

Multi attribute value theory

It is a particular type of multicriteria decision aiding method, it is based on a mathematical representation to facilitate decision-making process. It considers different attributes with several dimensions (in the case of this work, we cite, economic, historical, cultural, etc.) to evaluate the underlined objective. It also helps decision-makers to choose the best alternative decision to take, using a set of attributes that will be measured and presented as scores.

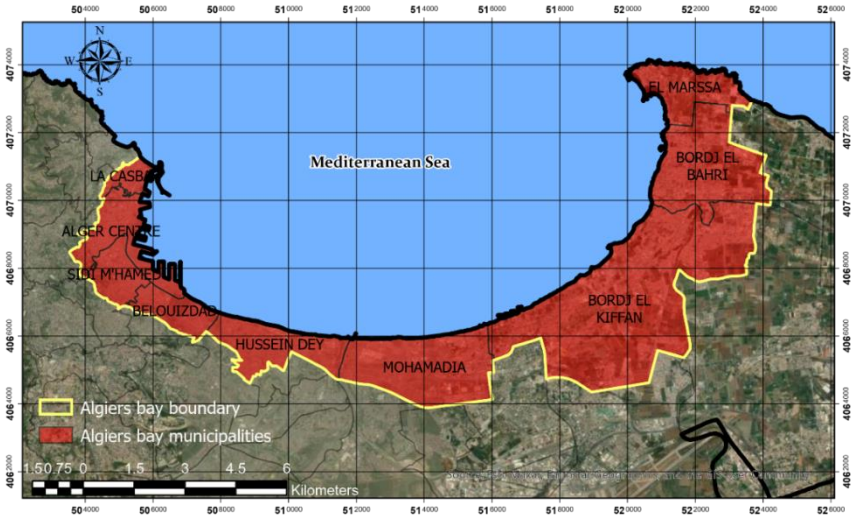

Figure 3. Location of the article case of study

Thanks to that method, all scores could be aggregated into a single value which will be used in helping decision-making process. So, the alternative with the best score will be the most susceptible to be chosen.

Thus, this method is based on the following steps:

Conceptualization

This step was realized by defining the main objectives of this study that need to be assessed. These objectives can be represented using a set of attributes and variables (this operation is based on the collection of information from a theoretical background).

According to Jiang and Ji (2002) those attributes may be co-operative or conflicting. Therefore, setting the appropriate attributes and variables leads the authors to perform a better diagnosis of the defined objective and then, respond appropriately.

Operationalization

After definition of the main attributes and variables of the outlined objective. This step focus on moving from abstract concepts to measured attributes (by converting them into a quantitative data). "Those attributes may be natural (extracted directly from definition of objective), constructed (they specify a finite number of degrees to which objectives are met), proxy (they are indirectly related to the definition of objective)" (Ferretti, Bottero, & Mondini, 2014, p. 4). These attributes can therefore be represented quantitatively or qualitatively, as in the case of the present research paper. Hence, a detailed explanation of this method can be found in the work of (Cheniki & Baziz, 2020; Da Cruz & Marques, 2017; Ferretti et al., 2014).

Decision making tool

This model was developed from literature review on heritage. It is therefore built based on six main attributes (natural heritage, architectural heritage, urban heritage, significance, authenticity and integrity). It is also developed according to a top-down approach. It is essentially based on the definition of the concept of tangible and intangible heritage, as well as on the objective of this work which is to assess the heritage value in an essential framework which is the development of tourism industry.

In this research paper, the evaluation of heritage value is carried out, considering two kinds of attributes: Tangible and Intangible.

Tangible attributes:

These measures the physical components of urban space, encompassing both natural elements (such as green spaces, gardens and parks) and man-made structures (including buildings, old neighborhoods, industrial heritage, etc.).

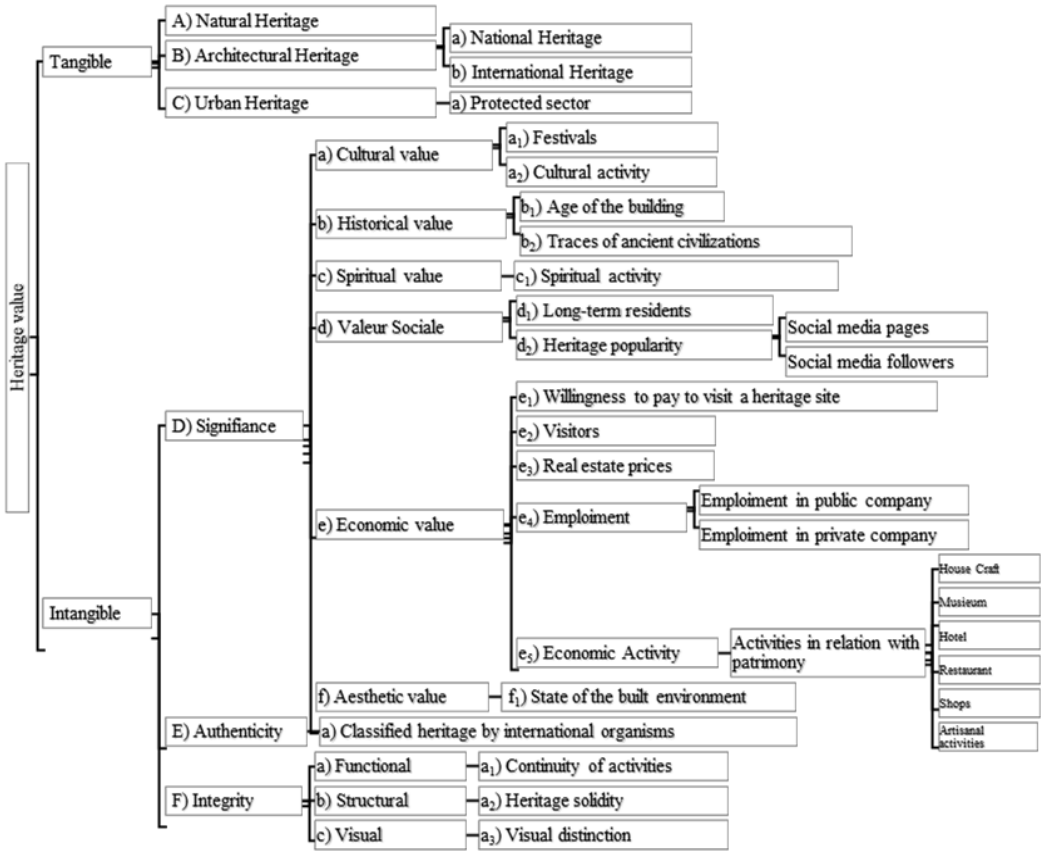

Figure 4. Decision making tool adopted for the evaluation of the heritage value

Intangible attributes:

This category aims to quantify intangible elements such as festivals, national holidays, cultural programs, etc. It is important to mention that the selection of these attributes is essentially based on theoretical background.

a) Authenticity

Assessment of authenticity has evolved through several global initiatives like The Venice Charter, World Heritage, The Nara, and The Burra Charter. Initially, it was focused on the physical aspects, later expanding to include tangible and intangible dimensions. The Charter of Venice (1964) and World Heritage Committee's 1978 criteria (Design, Materials, workmanship, and setting) highlight authenticity's importance in heritage protection. Silvio Mendes Zancheti and Hidaka (2011) propose a practical authenticity definition - the degree of a heritage's potential for being genuine or not. World Heritage Convention in 2005 introduced authenticity testing criteria: form, materials, use, traditions, location, intangible elements, etc. (WHC, 2013). Urban heritage, vital in socio-economic activities and tourism, embraces authenticity in fostering a Creative City concept (González Martínez, 2017). Authenticity, as per English heritage, embodies features truly

representing a place's cultural value (Drury, McPherson, & Heritage, 2008). It harmonizes conservation and development (Nezhad, Eshrati, & Eshrati, 2015). Heritage listed on the World Heritage List is deemed authentic through rigorous evaluation (Nezhad et al., 2015).

b) Significance

In the 1990s, UNESCO and the World Heritage Center recommended considering the significance of urban spaces for conservation. This variable aims to assess the meaningfulness of a space. Urban spaces are conserved because they hold values interconnected with other values (Silvio Mendes Zancheti, Hidaka, Ribeiro, & Aguiar, 2009). A study by Silvio Mendes Zancheti and Magalhães (2015) highlights a strong link between heritage conservation and its significance.

Researchers have established significance through the interaction of two elements: the Subject (attributing meaning to space) and the Object (space influencing the subject's behavior). This interdependence is emphasized by Frondizi (1971). Cultural heritage embodies a value stemming from the interaction between the object (heritage) and the subjects (ancestors) who imbue it with meaning. Interpreting all the values within a heritage is impossible, given its potential for carrying multiple values concurrently. The interpretation of cultural heritage's meaning varies based on the diverse actors utilizing urban space, although a study by Bakri, Ibrahim, Ahmad, and Zaman (2015) demonstrates similarity in the understanding of cultural heritage's significance among these actors. The Burra Charter (Icomos, 2000) links cultural value with its meaning, encompassing aesthetic, historical, scientific, social, and spiritual aspects. This definition has laid the foundation for assessing the significance of heritage elements. This indicator is measured by several variables :

- **The Aesthetics and visual appearance** hold a significant role in cultivating the cultural significance of heritage (Bakri et al., 2015). They play a vital part in promoting cultural and historical heritage, consequently contributing to the promotion of the city. The preservation and upkeep of the aesthetic aspects of historical heritage substantially contribute to drawing visitors, which in turn directly and indirectly stimulates the city's or country's economy. Swensen (2012) underscores the relevance of the contemplation concept for visitors who value modernity. This concept mirrors how visitors perceive historical and cultural heritage within the city, aligning with Lefebvre's perspective that explains this form of tourist behavior and inclinations through visual engagement.
- **Historical value** has an important link with the cultural significance of the construction. Indeed, a survey of buildings carried out by (Bakri et al., 2015) explains that there is an association between buildings and certain events.
- **Socio-cultural value**, is considered a significant heritage asset for the city, it is summed up in several intangible elements, such as language, customs and traditions, rituals, poetry, songs, even dance. Supriharjo, Pradinie, Santoso, Setiawan, and Rahmawati (2016) explain that bookstores contain the human heritage, their successes and failures, the works of intellectuals, scientists and artists. They therefore deserve to be preserved.
- **Spiritual value,** is related to the sacred and spiritual value of the space, as well as the impacts of heritage and beliefs. It is closely related to traditional and worship activities, Silvio Mendes Zancheti and Hidaka (2011) explain in this regard, that there are sites that derive their meaning from the cultural, traditional and worship activities found there, such as handicrafts and places of worship. These activities give a sense of authenticity and identity to these places.
- **Social value**: Rypkema and Cheong (2011) explain that pride in belonging to a society is considered a very important social value. Popularity of Heritage, is a direct effect of the valuation of a heritage. Indeed, the popularity of a heritage plays an important role in the attraction of a tourist destination. Long standing residents, explain that former residents play a very important role in sustainable heritage conservation (Silvio Mendes Zancheti & Hidaka, 2011; Silvio Mendes Zancheti & Magalhães, 2015). This category of space users maintains their properties and will work to make them better, contributing to the installation of activities such as trade and services, maintaining links between the different citizens of the community and preserving customs and traditions.
- **Economic value:** heritage conservation exerts a positive economic influence on a city (Rypkema & Cheong, 2011). Impact indicators include job creation, taxes, enhanced quality of life,

and citizen attachment to spaces. Heritage enhancement operations necessitate financial and material resources, fostering job opportunities among decision-makers, designers, and managers.
Employment and household income stand as key indicators in evaluating the economic impact of heritage enhancement (Rypkema & Cheong, 2011). The process demands resources during study and execution, leading to new job creation. Real estate prices also contribute to the link between heritage conservation and the economy. Determining heritage's impact on real estate value requires pre and post-upgrade comparisons, considering factors like location, facilities, and security.
Differentiating heritage conservation from simple building preservation, it adheres to universal standards to maintain authenticity, originality, and cultural significance. Factors such as building age, construction, history, architecture, type, function, size, and conservation methods influence the approach (Mahmoud, Khamidi, Idrus, & Ashola, 2015). Economically valuing heritage poses challenges globally, including in Algerian cities, where it's not treated as a market product (Mourato & Mazzanti, 2002). Heritage lacks a commercial price, often necessitating public authority financing. However, sporadic subsidies and the absence of regular financial support contribute to degradation, vandalism, theft, and overuse.

c) Integrity

Integrity has been applied since 1953 in the evaluation of historical sites in America. This attribute refers to the ability of a property to convey its meaning to the public over time. The examination of the conditions of integrity requires analysis of elements necessary to examine its universal value.

Stovel (2007) explains integrity by two essential elements:

- **"wholeness"** is whether all the elements are necessary to fully tell the story of the site and whether the property is big enough to contain all the elements and processes necessary to convey its significance.
- **"Intactness"** means inquiring about the state of the property in relation to the threats to its existence and possible risks in the surrounding environment.

Silvio Mendes Zancheti and Hidaka (2011) explain that integrity must go beyond the limits of heritage and include its cultural environment, in which it is built, used and even transformed. Furthermore, Jokilehto (2006) proposed three dimensions of integrity (socio-functional, structural and visual integrity).

- **Socio-functional integrity**

It is linked to the activities carried out, during the use of heritage in its historical development and the interfaces that the heritage site establishes with society, religion, the environment and the movement of people. Socio-functional integrity refers to the identification of the functions and processes on which its development over time has been based. It is the reference for understanding the significance of the different elements of the built environment (Sílvio Mendes Zancheti & Hidaka, 2012).

- **Structural Integrity**

It expresses the solidity of heritage that convey the messages of past civilizations. It thus defines the current reality on the ground, i.e., the elements that have survived in their actual historical state thanks to the evolution of the functions of the past. Even a cultural landscape can be defined in terms of historical integrity. Thus, it should be noted that the issue of functional integrity is relevant to urban or rural areas and to the planning and management of their current use.

- **Visual integrity**

It refers to the ability of objects (and processes) to visually (or aesthetically) express messages and meanings. Visual integrity is the result of certain processes. Therefore, in order to properly appreciate existing realities and possible changes, it is useful to refer again to functional and historical structural integrity.

Tangible attributes

d) Natural heritage refers to elements that reflect a historical value of a certain period.

e) Architectural heritage classified by national and international organizations.

f) Urban heritage classified by national and international organizations.

These two types encompass all elements of tangible heritage. It should be noted that researchers have agreed that the presence of heritage is correlated with certain elements, such as population density, presence of services and quality of accessibility. There is a direct relationship between heritage value and population density in a site. Historical and cultural heritage sites have high value in densely populated sites (Brander, Florax, & Vermaat, 2006; M. Brander et al., 2012; Wright & Eppink, 2016). For example, Silvio Mendes Zancheti and Magalhães (2015) explain that there is also a direct relationship between the preservation of historical and cultural heritage and the presence of transportation, commerce, garbage collection, health services, and public safety services. Thus, the age of the buildings represents the historical value of the heritage because it plays an important role in its enhancement. Once the decision-making tool has been adjusted for use in the evaluation process, the next step involves assessing the heritage value within the bay of Algiers.

This process is carried out following several steps:

Measuring the raw values

It is important to mention that the model's tree contains both of quantitative and qualitative attributes. the first type is therefore easier to measure, because, it was quantified using data collected from certain sources, as shown in (Table 1). Besides, qualitative attributes were quantified using a questionnaire by answering with a "Yes" or "No".

Table 1. Source of the database used in the calculation of indicators and variables used in the model tree of the heritage

Indicators			Variables	Source of information
Tangible	Natural heritage		-	(D.F.C.V, 2019)
	Architectural heritage		National heritage	(DCH, 2003)
			International heritage	
	Urban heritage		Protected sector	(Parquexpo, 2016)
Intangible	Significance	Cultural value	Festivals	(Parquexpo, 2016)
			Cultural activities	GIS of Algiers (2018) realized by the authors.
		Historical value	Age of the building	-
			Traces of ancient civilizations	(Parquexpo, 2016), (DCH, 2003).
		Spiritual value	Spiritual activity	GIS of Algiers (2018) realized by the authors.
		Social value	Long-term residents	(ONS, 2011)
			Heritage popularity	Number of followers in social media pages
		Economic value	Willingness to pay to visit a heritage site	-
			Number of Visitors	-
			Real estate prices	Calculated by the authors according to (OuedKniss, 2018)
		Aesthetic value	State of the built environment	Observation on site
	Authenticity		Classified heritage by international organisms	UNESCO
	Integrity		Functional	Observation on site (2020)
			Structural	Observation on site (2020)
			Visual	Observation on site (2020)

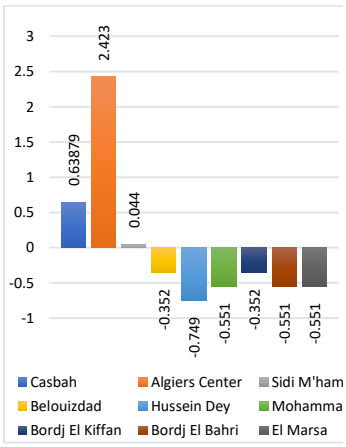

Figure 5. Cultural value

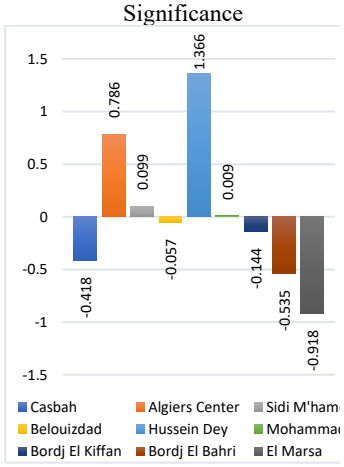

Figure 6. Economic value

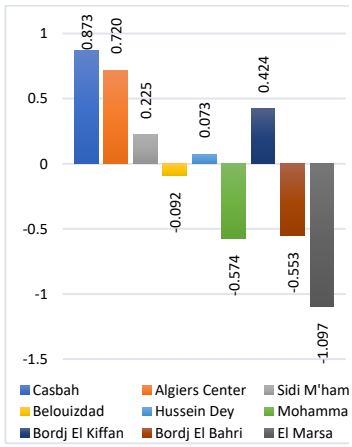

Figure 7. Social value

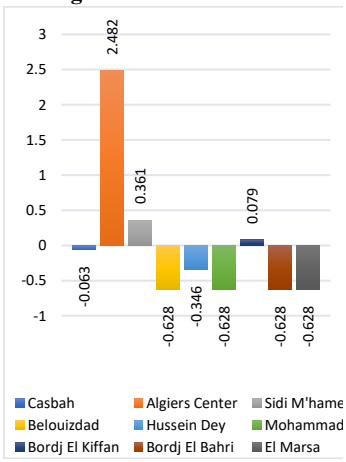

Figure 8. Historical value

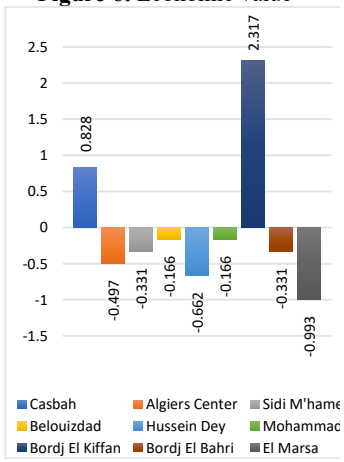

Figure 9. Spiritual value

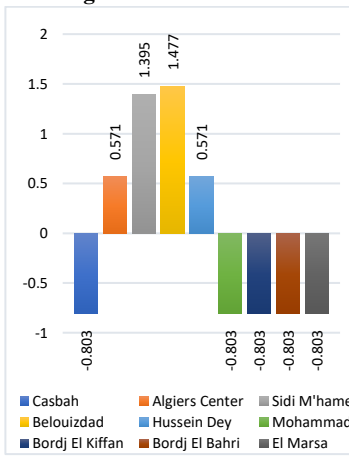

Figure 10. Aesthetical value

Integrity

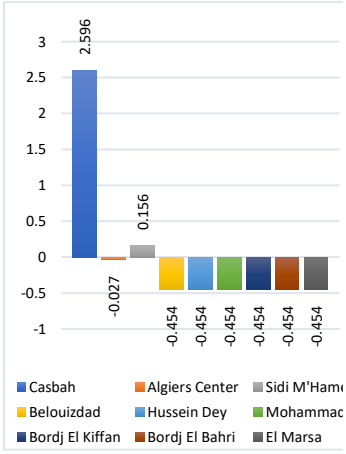

Figure 11. Functional integrity

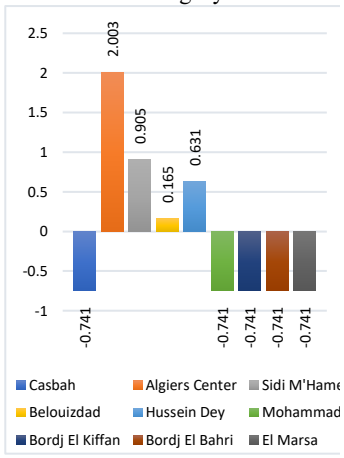

Figure 12. Structural integrity

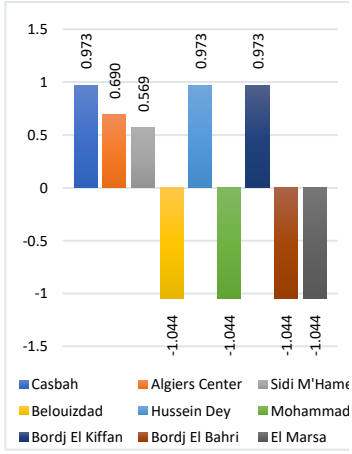

Figure 13. Visual integrity

Normalization (standardizing scores)

Raw scores obtained from measuring different attributes cannot be used directly, they need to be normalized in order to be compared (In this case we used Z-score equation). Z-score is measured based on the number of standard deviations. Thus, using z-score, values may be positive or negative (it is positive when the raw value is above the standard deviation and negative when it is under it), so, zero is considered as medium level, while positive values as highly appreciated and negative as lowly appreciated in measuring performance of the underlined objective.

The applicability of that equation relies on the existence of a multitude of samples with different raw scores in order to be compared (Abdi, 2007), using Equation 1:

$$\textit{Equation 1. Z-score} \quad Z = \frac{Y - M_Y}{S_Y}$$

The results derived from the normalization of data gathered from various sources, as outlined in Table 1, have been exhibited in Figures 5-13.

AHP method

The Analytic Hierarchy Process (AHP) (Thomas Lorie Saaty, 2008) is a widely used method for making complex decisions, especially in scenarios involving multiple indicators and variables. AHP provides a structured approach for breaking down a decision problem into a hierarchy of criteria and subcriteria, and then assessing the relative importance of these criteria through pairwise comparisons. These comparisons are often done using a scale that allows decision-makers to express their preferences between different elements of the hierarchy. The results of these comparisons are then synthesized using mathematical calculations to derive the overall priorities of the criteria and subcriteria (Cheniki & Baziz, 2020).

In the context of Multi-Attribute Value Theory (MAVT), AHP can be used to determine the weights of different attributes and subattributes in a decision problem. Once these weights are established, the attributes can be combined with individual performance scores for various alternatives to calculate an overall value or utility score for each alternative. This aids decision-makers in selecting the most suitable option based on the desired criteria and their relative importance (Linnemann, Hendrix, Apaiah, & van Boekel, 2015). AHP and MAVT are particularly useful when faced with complex decisions where multiple factors need to be considered, and there might be subjective judgments involved. These methods provide a systematic and rational framework to address such complexities and help decision-makers arrive at well-informed choices.

Thus, in the present work, this operation was realized following two steps:

The first step was realized by Creating a Pairwise comparison matrix: adjusting the importance scale based on input from experts in the field involved evaluating the significance of each indicator and variable within the decision-making tool. During this phase, the authors compared individual elements while considering their nature (attributes or variables). This scale enabled experts to make relative comparisons between diverse options falling within the same category.

According to Thomas Lorie Saaty (2008), nine scales are set for this operations: 1 – equal importance, 2 – weak or slight importance, 3 – moderate importance, 4 – moderate plus importance, 5 – strong importance, 6 – strong plus importance, 7 – very strong or demonstrated importance, 8 – very, very strong importance, and 9 – extreme importance.

Second, Weighing variables and indicators

In this study, a pairwise comparison matrix was constructed by seeking insights from a panel of 20 experts in the field. Their input was gathered to provide qualitative assessments using the AHP scale. Through this process, the relative importance or weight of each element was established. By comparing each element with others at the same level in the hierarchy, the study aimed to derive meaningful insights into their prioritization.

As per the methodology outlined by Almansi et al. (2022), the process of determining weights involved the following sequential steps:

Aggregating the values within each column of the matrix, as illustrated by (Equation 2) :

$$\textit{Equation 2:}\quad L_{ij} = \sum_{n=1}^{n} C_{ij}$$

(L_{ij} represents the pairwise comparison matrix total column value & C_{ij} represents the criteria applied for the analysis)

Achieving normalization by dividing each element within the matrix by the sum of values in its corresponding column. This strategic measure guarantees the matrix adheres to the principle of maintaining column sums at an equilibrium of 1. The formula used is presented as (Equation 3).

$$\textit{Equation 3:}\quad X_{ij} = \frac{C_{ij}}{\sum_{n=1}^{n} C_{ij}} \qquad (X_{ij} \textit{ is the normalized pairwise comparison matrix})$$

In the researcher's methodology, the process involves dividing the cumulative sum of the normalized row values within the matrix by the parameter count (N), a step achieved through the utilization of (Equation 4): This computational procedure, executed individually for each row corresponding to a criterion within the normalized matrix, yields the standard weight assigned to each criterion. These standard weights encapsulate the criterion's proportional significance within the decision-making context. These derived weights play a pivotal role in subsequent analytical stages and decision-making within the Analytic Hierarchy Process (AHP).

$$\textit{Equation 4:}\quad W_{ij} = \frac{\sum_{j=1}^{n} X_{ij}}{N} \qquad (W_{ij} \textit{ is the standard weight})$$

Estimation of the CR Score:

In gauging the Consistency Ratio (CR), a pivotal factor in evaluating the coherence of pairwise comparisons, the process involves a series of crucial steps:

Initially, the derivation of the weighted sum vector necessitates the application of criterion weights to corresponding columns of the original pairwise comparison matrix. This multiplication procedure is carried out individually for each criterion, beginning with the first and progressing sequentially. Following the acquisition of the weighted sum vector, the subsequent stage encompasses the formulation of the consistency vector. This entails dividing each element within the weighted sum vector by its corresponding criterion weight. This operational step ensures accurate representation of the influence of each criterion weight within the ultimate vector. Subsequently, the computation of Lambda (λ), which denotes the average value within the consistency vector, is executed. This computation provides a comprehensive gauge of the overall consistency of the system or data based on the weighted comparisons. To achieve the computation of consistency vector values, the application of (Equation 5) is enacted:

$$\textit{Equation 5:}\quad \lambda = \sum_{i=1}^{n} CV_{ij} \qquad (\lambda \textit{ is the consistency vector})$$

Furthermore, an integral facet involved the computation of the Consistency Index (CI), serving as a metric to quantify the extent of divergence from anticipated consistency. The CI serves to quantify the degree by which real-world consistency differs from the anticipated level, factoring in the criterion weights and their influence on the pairwise comparisons. This can be visualized through (Equation 6):

$$\textit{Equation 6:}\quad CI = (\lambda - n)(n - 1)$$

The assessment of inconsistency degree $(\lambda - n)$ gauges the extent of departure from the projected level of consistency, contingent upon the number of parameters involved.
The derivation of the Consistency Ratio (CR) rests upon a comparison between the Consistency Index (CI) and a reference value, typically founded on randomized consistency indices for matrices of akin dimensions. This comparative analysis assumes a paramount role, serving to ascertain the verdict on the congruity of the pairwise comparisons. Should the CR value fall within an acceptable threshold, it conveys a signal of reasonable coherence within the comparisons. However, if it ventures beyond this range, it triggers apprehensions regarding the dependability of decision-making predicated on the provided pairwise evaluations. This concept is encapsulated in (Equation 7):

Equation 7: $CR = CI/RI$ *(RI is the random index. RI depends on the number of elements being compared, as explained in Table 2)*

Table 2. Random inconsistency indices (RI)
(Source: Thomas L. Saaty, 1980)

n	RI
1	0.00
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.48
11	1.49
12	1.51
13	1.56
14	1.57
15	1.59

Following the outlined procedure, the implementation of the aforementioned steps led to the development of (Table 3). This table showcases the matrix of pairwise comparisons, illustrating how the various indicators used in the decision support tool for assessing the heritage value in the bay of Algiers.

Table 3. Pairewise comparison matrix

Matrix		Natural Heritage	Architectural Heritage	Urban Heritage	Significance	Authenticity	Integrity
		1	2	3	4	5	6
Natural Heritage	1	1	7/8	5/7	2/3	2/3	3/7
Architectural Heritage	2	1/7	1	1/5	2	4/5	4/7
Urban Heritage	3	3/8	5/6	1	5/7	6/7	7/9
Significance	4	3/5	1/2	4/7	1	2/5	2
Authenticity	5	1/2	1/4	1/6	1/2	1	1/5
Integrity	6	2/5	2/5	1/3	1/2	1/4	1

RESULTS

After following the steps already explained in the previous operations carried out to calculate the indicators and variables of the decision-making tool, we were able to obtain metrics, as presented in Table 4.

Table 4. Results obtained based on the experts' responses

n	6	Number of criteria (2 to 10)	Scale	1		AHP 1-9
N	20	Number of Participants (1 to 20)		0.1	Consensus	87.2%
p	0	Selected Participant (0=consol.)				Consolidated

	Indicator	Comment	Weights	+/-
1	Natural Heritage		16.7%	1.4%
2	Architectural Heritage		20.3%	2.2%
3	Urban Heritage		19.7%	2.2%
4	Significance		11.0%	1.3%
5	Authenticity		25.6%	1.8%
6	Integrity		6.6%	0.8%

Eigenvalue			Lambda	6.027		MRE	10.3%
Consistency Ratio	GCI	0.02	Psi	8.3%	CR	0.4%	

The evaluation of heritage value at the level of different municipalities of the bay of Algiers delivered the following information (Figures 14-19):

Tangible attributes

- 5/9 of the municipalities in the bay of Algiers show a weakness in terms of natural heritage (the Casbah, Algiers Center, Sidi M'hamed, Hussein Dey and El Marsa).
- 8/9 of the municipalities of the bay of Algiers present a weakness in terms of classified architectural heritage (Algiers Center, Sidi M'hamed, Belouizdad, Hussein Dey, Mohammadia, Bordj El Kiffan, Bordj El Bahri and El Marsa).
- 8/9 of the municipalities of the bay of Algiers present a weakness in terms of urban heritage (classified urban sites), (Algiers Center, Sidi M'hamed, Belouizdad, Hussein Dey, Mohammadia, Bordj El Kiffan, Bordj El Bahri and El Marsa).

Intangible attributes

- 4/9 of the municipalities of the bay of Algiers have failed to preserve the Significance of heritage in their urban space (Hussein Dey, Mohammadia, Bordj El Bahri, El Marsa).
- 8/9 of the municipalities of the bay of Algiers present a low degree of authenticity in their urban space (Algiers Center, Sidi M'hamed, Belouizdad, Hussein Dey, Mohammadia, Bordj El Kiffan, Bordj El Bahri and El Marsa).
- 4/9 of the municipalities of the bay of Algiers have a problem of heritage Integrity in their urban environment (Belouizdad, Mohammadia, Bordj El Bahri and El Marsa).

The analysis of the heritage value in Algiers Bay municipalities delivered the following results: the Casbah is classified among the municipalities having a very important heritage value, followed by the Belouizdad and Algiers Center (only these municipalities obtained positive scores). Besides, the rest of other municipalities (Sidi M'hamed, Bordj El Kiffan, Hussein Dey, El Marsa, Mohammadia and Bordj El Bahri) obtained negative scores as indicated in (Figure 20).

Tangible heritage

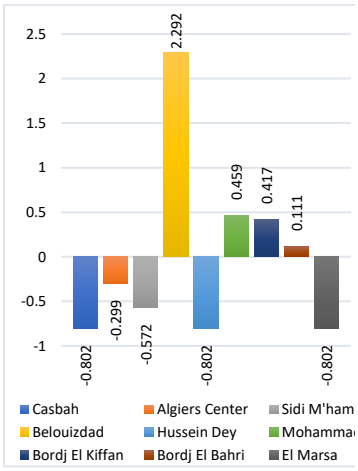

Figure 14. Naturel heritage

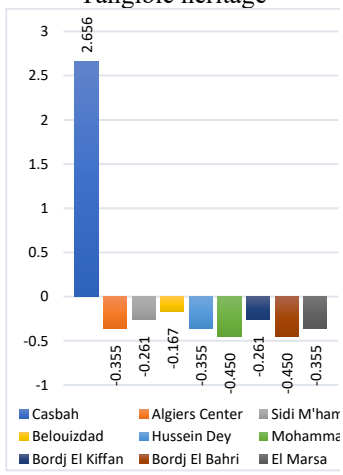

Figure 15. Architectural Heritage

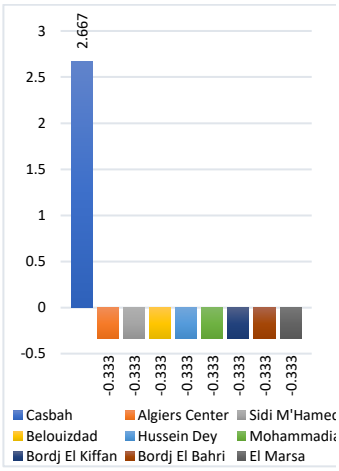

Figure 16. Urban Heritage

Intangible heritage

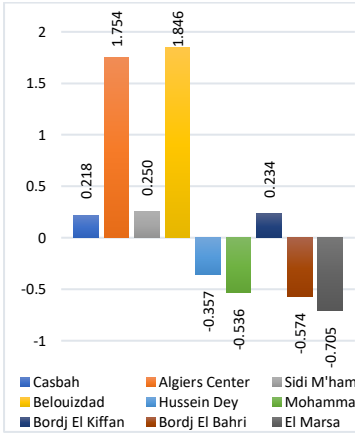

Figure 17. Significance

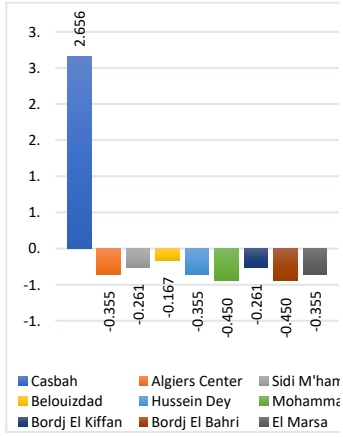

Figure 18. Authenticity

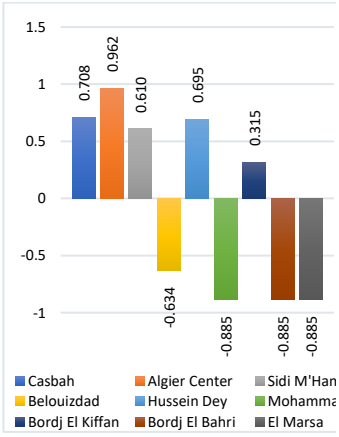

Figure 19. Integrity

These results were explained as follows:

The Casbah is classified as the best municipality with the most important heritage value. This information is justified by the fact that it is classified as a world heritage, this classification was made by UNESCO in 1992. Thus, it contains several heritage properties that deserve to be visited and upgraded. It is also noteworthy that it scored positively on the evaluation of intangible attributes such as significance, authenticity and integrity (Figure 17Figure 18Figure 19). For example, the analysis of the "significance" attribute in the case of this municipality revealed that it is positive in terms of cultural, social and spiritual value (Figure 5,Figure **7** and, Figure **9**), whereas it is less valued economically and historically (here the calculation is made taking into account the number of civilizations that have left their traces in this municipality, as well as the architectural styles it has in its urban space). Thus, the analysis of the attribute of integrity revealed that functional activity is preserved in a large part of its assets, despite its deterioration due to the non-preservation of its structural integrity. On the other hand, the Casbah still retains its unique visual distinction in the world. This evaluation revealed that the heritage value in the municipality of Belouizdad is ranked second. It has a great potential in natural heritage (the "Botanical Garden of Hamma" has a very

important potential and natural reserve for the municipality and the whole bay of Algiers). The processing of different information using the decision support tool revealed that the attribute of significance is positive, while those of authenticity and integrity are negative. It is remarkable that it suffers from several problems that have reduced its heritage value, for example, a weakness in terms of architectural and urban classified heritage. The evaluation of the attribute of significance revealed that this municipality presents several handicaps, such as a devalued cultural, economic, social and spiritual value (Figure 5Figure 6Figure 7Figure 9), as well as a low historical value.

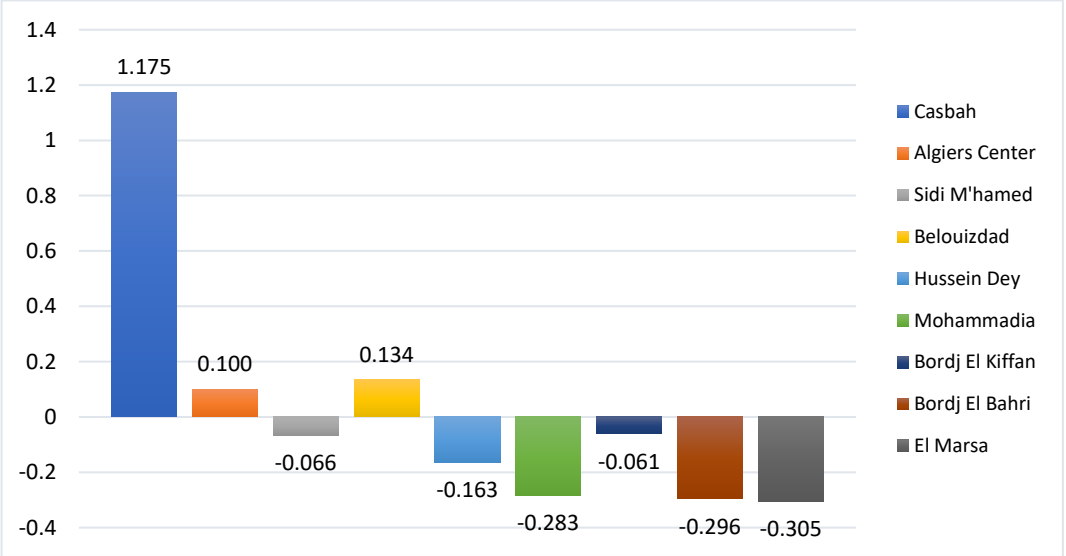

Figure 20. Classification of different municipalities of Algiers Bay according to their heritage value (Source: the author)

This analysis showed that the functional and visual integrity is negative, which explains that this municipality has not managed to preserve the continuity of the original function in its heritage, as well as its visual distinction. As for structural integrity, it is positive, which explains that this municipality has succeeded in preserving the solidity of the heritage. The municipality of Algiers Center, having an interesting heritage value is ranked third. Indeed, the analysis of this municipality using the decision support tool (Figure 4**)** showed that it had negative scores when evaluating tangible attributes (a weakness in terms of natural heritage (4.96 ha) and classified architectural and urban heritage). In addition, the evaluation of the intangible attributes showed that this heritage has on the one hand, retained its significance and integrity. On the other hand, the attribute of authenticity is negative, as this evaluation is based on the findings of national bodies in the classification of national heritage. The analysis revealed that the intangible attributes had positive scores compared to the tangible attributes in the municipality of Algiers center. Indeed, this municipality presents positive scores when talking about cultural, economic, social, historical and aesthetic values, which made the heritage value more significant, except for the spiritual value which remains timidly negative. Moreover, the heritage value is more structurally and visually preserved, but has lost its original functional value in this urban space. The other municipalities of the bay of Algiers, present a globally negative heritage value. The municipality of Bordj El Kiffan is classified as having a negative score in the evaluation of the value of the heritage. Regarding tangible attributes, the analysis revealed a weakness in architectural and urban heritage, while natural heritage is positive (12.02 ha of natural heritage according to the Forestry Department (D.F.C.V, 2019)).

On the other hand, for intangible attributes, the evaluation revealed a weakness in terms of authenticity. However, this heritage is, in fact, significant. It is also positive in terms of attributes of

integrity. A more detailed analysis of the intangible attributes for this municipality explains some of the points of the result obtained when ranking this municipality. Indeed, the analysis of the significance of the heritage value revealed that the cultural, economic and aesthetic aspect related to the heritage value is weak (Figure 5Figure 6Figure 10). On the other hand, the social, historical and spiritual aspects of the heritage is well valued (Figure 7Figure 8 and,Figure **9**). Indeed, the evaluation of the integrity of the heritage revealed that this municipaliy has preserved its visual integrity (visual distinction), whereas it has lost its functional (continuity of antecedent functions) and structural integrity (solidity of the heritage). The same evaluation process applied to the municipality of Sidi M'hamed revealed a negative score in terms of heritage value, this is due to several factors, like a weakness in tangible attributes (natural, architectural and urban heritage). A weakness in intangible attributes, it is indeed remarkable that the heritage value at the level of this municipality has kept its significance and integrity, whereas it has a weakness in authenticity (because of the weak existence of classified heritage in this municipality). Indeed, the analysis of the attribute of significance showed that this municipality has succeeded in preserving the value of its cultural, economic, social, historical and aesthetic heritage. On the other hand, it has a weakness in spiritual value. Thus, the analysis of integrity demonstrated that there is continuity of functions in its heritage, as well as the strength of its structure and its visual distinction. The evaluation of the heritage value at the level of the municipality of Hussein Dey gave negative scores. This is due to several factors, mainly a weakness in terms of classified natural, architectural and urban heritage (tangible attributes) (Figure 14Figure 15Figure 16). Concerning the intangible attributes, this evaluation revealed that the heritage value at the level of this municipality has a weakness in terms of significance and authenticity, while it received positive scores in terms of integrity. A detailed evaluation of significance and integrity revealed that it is devalued particularly in terms of cultural, historical and spiritual value, while it is valued economically and aesthetically. As far as integrity is concerned, it is indeed remarkable, that this municipality lacks a functional continuity of heritage, with a solid heritage (solid structure) and visual distinction.

The municipality of Mohammadia also presents a negative score when assessing the heritage value of its urban space. This is mainly due to several factors, including: a weakness in tangible attributes whether natural, architectural or urban (lack of architectural and urban heritage in this municipality). All this explains the weakness in the attribute of authenticity, as well as the integrity which are part of the intangible attributes. In addition, a more detailed analysis of the intangible attributes showed that the cultural and social, historical, spiritual and aesthetic aspects of heritage are devalued. While the economic aspect is valued, this is due to the relationship of several factors, of which heritage valuation is one of them. The same evaluation made at the level of the municipality of Bordj El Bahri revealed a negative score. Indeed, the analysis showed that this municipality has a weakness in terms of architectural and urban heritage. In addition, it presents a positive score in natural heritage (tangible attributes). Regarding the intangible attributes, the significance score is negative, as well as authenticity and integrity, this is explained by a lack of tangible heritage in this municipality. Indeed, a more detailed analysis of the indicators of significance reveals that the cultural, economic, social, historical, spiritual and aesthetic aspects of the heritage are devalued. In addition, the evaluation of the municipality of El Marsa obtained a negative score, this is mainly due to several factors like weakness in tangible attributes (natural heritage, architectural and urban heritage) as well as in intangible attributes (significance, authenticity and integrity). The detailed analysis of the attributes of significance and integrity reveals that the scores are negative with all the variables used to evaluate these two attributes. This means that the heritage value in this municipality has a weakness in terms of cultural, social, economic, spiritual, historical and even aesthetic value. Added to this, a weakness in integrity and in terms of the continuity of the heritage activity, the solidity of the structure of the legacy and it is beginning to loose its visual distinction.

Model's Validation

Carayannis et al. (2018) argue that it is possible to validate results by engaging a panel of experts who were part of the study. In our own validation process, we drew upon the CR analysis

which is used by many researchers such as (Almansi et al., 2022; Jin Su Jeong, González-Gómez, & Cañada-Cañada, 2019), along with a 95% confidence interval assessment (Almansi et al., 2022; Penfield & Miller, 2004). Additionally, we considered scores derived from sensitivity and robustness analyses (Carayannis et al., 2018; Jin Su Jeong, 2018; Jin Su Jeong et al., 2019; Mateus, Ferreira, & Carreira, 2008; Mészáros & Rapcsák, 1996) to strengthen the validation of our findings. As it is shown in (Table 4), a consensus of 87.2% indicates a high level of consistency in the decision outcomes among different experts in the field. It suggests that the model's results are widely accepted and trusted by the majority of the involved parties. A high consensus value is desirable as it reflects a robust decision-making process, where multiple perspectives have been considered, and the decisions are well-supported by the experts.

A consistency ratio of 0.4% indicates a high level of consistency. In the context of AHP, a consistency ratio less than 10% is generally considered acceptable, as it suggests that the pairwise comparisons made by decision-makers are reasonably consistent.

A low “GCI” value, such as 0.02, suggests that the decision outcomes are globally consistent, meaning that they align well with the criteria weights and decision preferences. It indicates that the model is producing consistent and reliable results across all criteria, and the decision results are in harmony with the experts' preferences.

As it is shown in (Table 5), the 95% confidence interval for the AHP model indicates the range within which we can be 95% confident that the true value lies. In this case, the estimate of the model's performance is expected to fall between the lower and upper bounds. The Std. Error (Standard Error) represents the variability or uncertainty in the estimate. A lower standard error implies that the estimate is more precise and less variable. In this case, we can be 95% confident that the true value of the model's performance lies within the range of 0.0558 to 0.352, with a standard error of 0.075.

Table 5. Confidence interval

	95% confidence interval		
Model	Std. Error	Lower Bound	Upper Bound
AHP	0.075	0.0558	0.352

Based on (Table 6), comparing sensitivity and robustness values, we can observe that indicators with lower sensitivity values tend to have higher robustness scores. This indicates that the indicators with lower sensitivity are more stable and produce more consistent results, making them less sensitive to changes in their weights. Indicators with higher sensitivity values, such as "Significance" and "Integrity," may lead to more variable decision outcomes when their weights are changed. On the other hand, indicators with lower sensitivity values, such as "Urban Heritage" and "Authenticity," are less prone to significant changes in decision outcomes when their weights are altered. "Architectural Heritage" has the highest robustness score (0.801), indicating it is the most stable and consistent indicator in the model. "Urban Heritage" has the lowest sensitivity (0.111), suggesting that its weight has the least impact on the decision outcomes.

Broadly, the model seems to be relatively robust as most indicators have high robustness scores, indicating stable and consistent decision outcomes.

Table 6. Sensitivity and Robustness Analysis

Indicators	Sensitivity anaysis	Robustness analysis
significance	0.369	0.510
authenticity	0.145	0.598
integrity	0.479	0.644
Natural Heritage	0.259	0.551
Architectural Heritage	0.145	0.801
Urban Heritage	0.111	0.691

CONCLUSION

The evaluation and prioritization of different municipalities of the bay of Algiers, according to the heritage value, has enabled us to deliver a classification of those deserving more attention as a priority, in order to guarantee an attractive space in terms of relevant heritage value that serves to build and strengthen the identity of the city of Algiers, in order to attract investors and tourists. Then, the evaluation of the heritage value, led us to obtain three types of results, such as firstly, a decision support tool to help decision-makers assess the value of historical heritage at the local scale. This tool is built on a theoretical background that deals with the subject of heritage, its characteristics and the attributes and variables that define it. Indeed, this tool is composed of six attributes and 27 variables. Secondly, to obtain a classification of the different municipalities according to their heritage value. This classification helps us to identify the municipalities with the most valued heritage. The application of this model in the case of the municipalities of the bay of Algiers has allowed us to obtain the following results: The Casbah is thus ranked first followed by Blouizdad, Algiers Center, Bordj El Kiffan, Sidi M'hamed, Hussein Dey, El Marsa, Mohammadia and finally Bordj El Bahri and El Marsa.

It should be noted that only 33.33% of this urban space have a very significant heritage value. It is obvious that the Casbah will have a higher score than the other municipalities, given its wealth of heritage (architectural or urban) which makes up its municipal space, as well as the importance given to its heritage. This municipality is followed by Belouizdad and Algiers Center. These two municipalities are the only that score positively and deserve more attention. Besides, the other municipalities were less valued in terms of heritage value. Thirdly, to highlight barriers to better heritage value in each municipality, we considered several elements of urban space, whether tangible or intangible.

This evaluation has provided us the following information: concerning the tangible heritage, this evaluation revealed that 55.5% of this urban space have weakness in natural heritage, in addition, 88.9% have a weakness in architectural and urban classified heritage. Concerning intangible heritage, this evaluation revealed that 44.4% of the municipalities of the bay of Algiers failed to preserve the significance and integrity of heritage in their urban space. Thus, 88.9% of the municipalities of the bay of Algiers present a low level of authenticity. The results were validated using various metrics, including a CR (Consistency Ratio) of 0.4%, GCI (Global Consistency Index) of 0.02, sensitivity analysis, and robustness analysis, which confirms the resilience of the AHP (Analytic Hierarchy Process) model. Additionally, the model's performance was substantiated by a 95% confidence level, indicating a standard error of 0.075. Heritage plays an important role in strengthening the local identity, thus paving the way for the tourism industry to become a driving force in the development of the economy.

So, through the present work, we have identified the municipalities that have a very interesting heritage value, so it is up to the public authorities to take charge of this heritage, to preserve and enhance it so that it becomes a destination for tourists around the world.

It is important to note that citizens play an important role in the process of the conservation of heritage, whether tangible or intangible, because in order to succeed in this kind of operations, it is of great necessity to think about integrating citizens in this kind of operations, so that they are made aware of the importance of the heritage value in the development of the city.

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