PROTECTION OF CULTURAL HERITAGE

EVALUATING AUTHENTICITY IN HERITAGE: A QUANTITATIVE FRAMEWORK

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ABSTRACT: Authenticity has long been regarded as an essential criterion for valuing heritage. While the Venice Charter presents a paradigm for international conservation policies aimed at general heritage protection, the Nara Document advances this by emphasizing the importance of authenticity with respect to context-oriented concerns. However, in both frameworks, assessment of authenticity remains a qualitative matter. In fact, current practices reveal that there are no quantitative assessment systems, which, if available, could provide measurable metrics to evaluate the level of authenticity of heritage with contextual objectivity. In this context, recently, the author, as part of a doctoral research, developed a framework referred to as the Quantitative Architecture Authenticity Metrix (QAAM) to assess authenticity of heritage buildings. It combines a quantitative metric with the cultural context to capture both tangible and intangible values, including community perceptions. This paper examines the possibility of quantitatively assessing heritage authenticity by employing this framework. The study evaluates the ability of the framework to assess and quantify authenticity by pilot testing of selected heritage buildings from different contexts. The findings demonstrate the effectiveness of the framework in quantitatively evaluating various aspects of heritage authenticity. They also provide evidence for the appropriateness and validity of the framework in evaluating authenticity of heritage.

Introduction

The growing complexity of heritage conservation demands tools that can evaluate authenticity in terms of both tangible and intangible dimensions. While conventional frameworks, such as the Venice Charter and the Nara Document, emphasize authenticity, the mechanisms for evaluation often remain qualitative in nature, leaving gaps in the systematic assessment of heritage. In response to this challenge, this paper introduces the Quantitative Architecture Authenticity Matrix (QAAM): a standardized yet flexible framework designed to assess authenticity of heritage buildings across culturally diverse contexts. By integrating measurable indicators with culturally rooted narratives, QAAM offers a hybrid approach that balances quantitative rigor with contextual sensitivity.

The aim of this study is to validate the culturally adaptable authenticity assessment matrix known as QAAM that evaluates both tangible and intangible values in heritage contexts. To achieve this, the paper seeks to fulfil the following objectives:

- To present the multi-dimensional evaluation matrix referred to as QAAM which combines qualitative and quantitative criteria.

- To assess the applicability of QAAM across diverse architectural, functional and cultural contexts.

- To test the matrix through expert assessments of internationally varied heritage sites.

- To refine the framework based on expert feedback and comparative analysis.

1. Theoretical Framework: Understanding Authenticity in Heritage Conservation

The concept of authenticity in heritage conservation has undergone significant transformations, driven by shifting philosophical paradigms and contextual challenges. Historically, authenticity has been defined primarily by material integrity and originality, but this understanding has evolved as conservation practices have moved beyond Eurocentric frameworks to embrace a more global view of cultural diversity. For instance, Jokilehto[1] notes that the concept of authenticity expanded as the field recognized the need for broader cultural inclusivity, marking a pivotal shift in how authenticity is understood and applied across different contexts. This evolution also ties into the rise of cultural relativism, which calls for authenticity to be viewed as a dynamic, context-dependent construct rather than a fixed, universally defined attribute[2].

Initially, foundational charters such as the Venice Charter[3] underscored the importance of preserving material fabric, form, and structure as central to the notion of authenticity. However, this material-focused interpretation of authenticity has been increasingly critiqued for its failure to account for the symbolic, spiritual, and lived dimensions of heritage. *Nara Document on*

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[1]   Jokilehto, J. (2006). *A history of architectural conservation* (2nd ed.). Routledge.
[2]   Smith, L. (2006). *Uses of heritage*. Routledge.
[3]   ICOMOS. (1964). *The Venice Charter: International Charter for the Conservation and Restoration of Monuments and Sites*. https://www.icomos.org/charters/venice_e.pdf

Authenticity[4] produced by ICOMOS has responded to this critique by shifting the discourse to include the idea that authenticity should be understood within the cultural context in which a heritage site exists. Indeed, this shift has allowed for multiple expressions of authenticity, expanding the notion beyond physical preservation to encompass traditions, meanings, and community narratives that imbue heritage with its values[5].

Constructivist approaches to heritage have further refined the understanding of authenticity by emphasizing that meaning is co-created between communities and the heritage sites. In this connection, Guba and Lincoln argue that authenticity is not a fixed, inherent quality of a material object, but rather a dynamic experience shaped through human interactions, memories, and evolving cultural practices. In fact, Labadi[6] and Kermani[7] point out that this approach resonates particularly in urbanizing societies, where heritage must adapt to changing socio-political and functional realities while maintaining connections to its cultural past.

Moreover, authenticity is closely tied to issues of identity, belonging, and representation, especially in post-colonial and religiously diverse societies. This is asserted by Denyer and Cohen and Cohen[8] who discuss how colonial buildings in South Asia or Islamic tombs like Humayun's take on varying symbolic meanings depending on the historical experiences and contemporary values of the communities. These layered meanings, combined with the spiritual significance of spaces, ritualistic uses of architecture, and localized aesthetic expressions, complicate the development of standardized assessments of authenticity.

To navigate this complexity, recent scholarship has called for frameworks that integrate both tangible and intangible values. Kermani[9] emphasizes the need for contextual objectivity, a concept that advocates for balancing measurable evaluations with cultural subjectivity. This approach acknowledges that while objectivity is crucial for comparability and policy development, it must remain sensitive to the unique cultural contexts and community perceptions that shape heritage.

The Quantitative Architecture Authenticity Matrix (QAAM), which this research presents, builds upon this evolved understanding of authenticity. It posits that authenticity should not be seen as an absolute quality but as a spectrum, influenced by material conditions, cultural narratives, and functional relevance. By incorporating both qualitative matrices such as the Perceived Authenticity Matrix (PAM) and quantitative assessments grounded in expert and community consensus, QAAM offers a more nuanced, inclusive, and globally adaptable framework for evaluating authenticity in heritage sites.

4   ICOMOS. (1994). *The Nara Document on Authenticity.* https://www.icomos.org/charters/nara-e.pdf

5   Smith, L. (2006). *Uses of heritage.* Routledge.

6   Labadi, S. (2010). Preserving cultural heritage for social inclusion: The role of the UNESCO World Heritage Convention. *International Journal of Heritage Studies,* 16(6), 405–422. https://doi.org/10.1080/13527258.2010.505104

7   Kermani, M. (2020). Heritage conservation in rapidly urbanizing contexts: A South Asian perspective. *Journal of Urban Cultural Studies,* 7(2), 189–208. https://doi.org/10.1386/jucs_00025_1

8   Cohen, E., Cohen, S. A. (2012). Authentication: Hot and cool. *Annals of Tourism Research,* 39(3), 1295–1314. https://doi.org/10.1016/j.annals.2012.03.004

9   Kermani, M. (2020). Heritage conservation in rapidly urbanizing contexts: A South Asian perspective. *Journal of Urban Cultural Studies,* 7(2), 189–208. https://doi.org/10.1386/jucs_00025_1

2. Literature Review

Assessment of authenticity in heritage conservation has seen substantial conceptual development over recent decades, transitioning from rigid, material-based models to more fluid, context-aware methodologies. Early frameworks, such as the *Venice Charter,* prioritized physical integrity emphasizing elements like design, materials, workmanship, and setting[10]. However, this material-centric perspective has been widely critiqued for its universalist assumptions and limited engagement with cultural diversity. Jokilehto[11], for instance, argues that such frameworks insufficiently accommodate the socio-cultural contexts that shape heritage meanings across different geographies.

A significant turning point in this discourse came with the *Nara Document on Authenticity,* which challenged the universality of material authenticity by framing it as culturally relative and multidimensional[12]. This document shifted the evaluative lens toward intangible dimensions—such as spiritual value, collective memory, and local identity—thus validating diverse cultural expressions of heritage. Smith[13] reinforces this perspective by suggesting that authenticity is not embedded solely in material fabric but also in the meanings communities ascribe to heritage, a point further expanded by Labadi[14], who emphasizes the document's role in legitimizing plural heritage narratives.

Building on this momentum, the ICOMOS 2011 *Guidance on Heritage Impact Assessments* attempted to operationalize a more integrated framework, one that accounted for both tangible and intangible values. While the guidance has provided structured tools to support this approach, it has stopped short of offering consistent methodologies that could ensure cultural adaptability in diverse field applications[15] . As Avrami and Mason[16] observe, the gap between theoretical inclusivity and practical application continues to pose a critical challenge, particularly in efforts to reconcile objectivity with cultural specificity.

In terms of methodology, the literature reflects a growing tension between qualitative and quantitative approaches to authenticity assessment. McClelland et al.[17] have championed qualitative models for their capacity to capture site-specific narratives and lived experiences. However, these models often lack standardization, making cross-cultural comparisons difficult.

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[10]   ICOMOS. (1964). *The Venice Charter: International Charter for the Conservation and Restoration of Monuments and Sites.* https://www.icomos.org/charters/venice_e.pdf

[11]   Jokilehto, J. (2006). *A history of architectural conservation* (2nd ed.). Routledge.

[12]   ICOMOS. (1994). *The Nara Document on Authenticity.* https://www.icomos.org/charters/nara-e.pdf

[13]   Smith, L. (2006). *Uses of heritage.* Routledge.

[14]   Labadi, S. (2010). Preserving cultural heritage for social inclusion: The role of the UNESCO World Heritage Convention. *International Journal of Heritage Studies,* 16(6), 405–422. https://doi.org/10.1080/13527258.2010.505104

[15]   ICOMOS. (2011) *Guidance on heritage impact assessments for Cultural World Heritage Properties.* https://openarchive.icomos.org/id/eprint/266/1/Guidance_on_heritage_impact_assessments.pdf

[16]   Avrami, E., Mason, R. (2019). *Values and heritage conservation: A critical approach.* Routledge.

[17]   McClelland, A., Jones, S., Tully, G. (2019). *Heritage and community engagement: Collaboration or contestation?* Manchester University Press.

On the other hand, Martínez and Cohen and Cohen[18] highlight that while quantitative methods offer replicability and consistency, they frequently fall short in addressing the emotional, symbolic, and evolving dimensions of heritage. This methodological divide underscores the need for hybrid frameworks that can bridge empirical analysis with cultural insight.

Efforts to address this gap are evident in models such as the Nara Grid[19] and UNESCO's Historic Urban Landscape (HUL) approach[20]. These models represent early attempts to synthesize multiple value systems and stakeholder perspectives. Yet, as Bandarin and Van Oers[21] and Apaydin[22] argue, these tools often remain embedded at the policy level and fail to offer robust mechanisms for assessing authenticity at the local scale—particularly in rapidly urbanizing cities. Case studies from urban centers such as Shiraz, Cairo, and Ahmedabad reveal that without localized assessment tools, top-down conservation policies risk displacing communities, accelerating gentrification, and eroding intangible cultural heritage[23].

When it comes to the development of quantitative models, scholarly contributions remain relatively limited. Ulukan and Arslan[24], for example, has proposed a rating system based on fuzzy logic implemented via MATLAB-2010b, aiming to bring greater objectivity to the assessment process. However, their method has yet to gain acceptance in mainstream heritage practices. More recently, Huang et al.[25] have employed Multi-Criteria Decision-Making (MCDM) methods alongside fuzzy cognitive mapping to assess authenticity in historic buildings at Wuhan University of Technology. While innovative, their approach has produced results that appear to lean more towards qualitative interpretations, signalling persistent difficulties in translating complexity into purely numerical outputs.

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[18]   Cohen, E., Cohen, S. A. (2012). Authentication: Hot and cool. *Annals of Tourism Research,* 39(3), 1295–1314. https://doi.org/10.1016/j.annals.2012.03.004

[19]   Van Balen, K. (2008). *Experimenting with the 'NARA-grid', an evaluation scheme based on the Nara Document on Authenticity*. APT Bulletin.

[20]   UNESCO (2011). *Recommendation on the Historic Urban Landscape.* UNESCO.

[21]   Bandarin, F., Van Oers, R. (2012). *The historic urban landscape: Managing heritage in an urban century.* Wiley-Blackwell.

[22]   Apaydin, V. (Ed.). (2020). *Critical Perspectives on Cultural Memory and Heritage. Construction, Transformation and Destruction.* UCL Press. https://doi.org/10.14324/111.9781787354845

[23]   Winter, T. (2014). Heritage conservation futures in an age of shifting global power. *Journal of Social Archaeology,* 14(3). https://doi.org/10.1177/1469605314532749; Labadi, S. (2010). Preserving cultural heritage for social inclusion: The role of the UNESCO World Heritage Convention. *International Journal of Heritage Studies*, 16(6), 405–422. https://doi.org/10.1080/13527258.2010.505104

[24]   Ulukan, M., Arslan, H. (2012). Developing a new authenticity rating system on architectural conservation. *The Sustainable City,* 155, 1235–1244. https://doi.org/10.2495/SC121031

[25]   Huang, B., Liu, L., Lyu, S., Li, Z. (2024). Evaluation of the protection of historical buildings in universities based on RCM-AHP-FCE. *Buildings*, 14(7), 2078. https://doi.org/10.3390/buildings14072078

Regionally, some frameworks have made advances in integrating local values. Most notable among them is the "China Principles"[26], which provides a compelling example of context-sensitive conservation. However, as Su and Kermani[27] note, the cultural specificity of such models restricts their broader applicability, particularly in transnational or comparative contexts. These limitations highlight the pressing need for assessment systems that can incorporate adaptive reuse, socio-religious symbolism, and community-driven values without defaulting to Eurocentric conservation standards.

Contemporary scholarship has responded to this challenge by advancing the notion of "contextual objectivity," which Cohen and Cohen[28] describe as a middle ground one that permits shared evaluative frameworks while allowing interpretive flexibility. DeSilvey[29] builds on this by advocating for participatory engagement and empirical grounding as essential components of any legitimacy-seeking authenticity model.

Ongoing research reflects a growing ambition to establish mathematical infrastructure for evaluating authenticity, aimed at generating transparent, score-based grading systems. Yet, as the literature consistently suggests, a fully integrated and widely accepted model remains elusive underscoring both the promise and the unresolved tensions of advancing quantitative approaches to authenticity assessment in contemporary heritage conservation. In this contexts, emerging tools such as the Quantitative Architecture Authenticity Matrix (QAAM) represent significant progress. It has been developed as an innovative tool to assess the authenticity of heritage sites by integrating both qualitative and quantitative metrics. Developed with both numerical rigor and cultural adaptability in mind, QAAM seeks to quantify authenticity through structured metrics while grounding its application in both expert analysis and community perception[30]. Its flexibility and adaptability aim to ensure applicability across varied cultural, socio-political, and historical contexts in global conservation practices.

3. Quantitative Architecture Authenticity Matrix (QAAM)

The Quantitative Architecture Authenticity Matrix (QAAM) is a comprehensive framework designed to assess and quantify authenticity of heritage buildings through the integration of both tangible and intangible factors. The tool comprises four core dimensions, each of which plays a vital role in evaluating the overall authenticity of a site. These dimensions are:

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[26]   ICOMOS China. (2015). *Principles for the conservation of heritage sites in China.* https://openarchive.icomos.org/id/eprint/1650/

[27]   Kermani, M. (2020). Heritage conservation in rapidly urbanizing contexts: A South Asian perspective. *Journal of Urban Cultural Studies,* 7(2), 189–208. https://doi.org/10.1386/jucs_00025_1

[28]   Cohen, E., Cohen, S. A. (2012). Authentication: Hot and cool. *Annals of Tourism Research,* 39(3), 1295–1314. https://doi.org/10.1016/j.annals.2012.03.004

[29]   DeSilvey, C. (2017). *Curated Decay. Heritage beyond Saving.* University of Minnesota Press.

[30]   Avrami, E., Mason, R. (2019). *Values and heritage conservation: A critical approach.* Routledge; McClelland, A., Jones, S., Tully, G. (2019). *Heritage and community engagement: Collaboration or contestation?* Manchester University Press.

I. Architectural/Structural Authenticity: This dimension examines the integrity of the physical structure and the preservation of original architectural elements. It focuses on the retention of design, materials, and construction techniques, assessing how well these attributes align with the heritage value of the building[31]. Reversibility of interventions and the impact of adaptive reuse are key considerations in this factor.

II. Functional/Activity Authenticity: This component evaluates the continued relevance of the original or adapted use of a building. It assesses the degree to which the current functions align with or diverge from the historical or intended activities of the building. This dimension accounts for the capacity of the building to maintain its original purpose or adapt to new uses while preserving its core authenticity[32].

III. Contextual Authenticity: This dimension focuses on the cultural, historical, and spatial contexts within which a building is situated. It acknowledges that authenticity is not only an inherent quality of the building itself but also depends on its broader environmental and socio-cultural context. For example, the alignment of the building with regional aesthetic preferences, such as color palettes or spatial organization, is considered. The contextual factor is essential for understanding how the building engages with its surrounding, reflecting the broader narratives and cultural significance it embodies[33].

IV. General Perception: This factor evaluates the overall significance and perception of authenticity from the perspectives of different stakeholders, including local communities, heritage experts, and the public. It captures the emotional resonance and symbolic meaning of the heritage site, as well as the collective memory and identity that it represents. General perception provides a subjective yet integral component in determining authenticity by reflecting societal values[34].

3.1. Distinctive Characteristics of QAAM

Contextual Objectivity: One of the distinguishing features of the QAAM is its ability to incorporate cultural sensitivity into the evaluation process. The tool allows for the accommodation of regional preferences, including variations in aesthetic traditions, spatial arrangements and historical narratives, ensuring that assessments remain grounded in the local context. For instance, different regions may prioritize distinct color schemes or architectural typologies, which QAAM

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[31]   ICOMOS (2013). *Values and Authenticity: Charter and Doctrinal Texts.*

[32]   Avrami, E., Mason, R. (2019). *Values and heritage conservation: A critical approach.* Routledge.

[33]   Jokilehto, J. (2006). *A history of architectural conservation* (2nd ed.). Routledge; Labadi, S. (2010). Preserving cultural heritage for social inclusion: The role of the UNESCO World Heritage Convention. *International Journal of Heritage Studies,* 16(6), 405–422. https://doi.org/10.1080/1352 7258.2010.505104

[34]   Schultz, J. (1980). *Place and identity: Interpretations of locality in heritage contexts.* Heritage Press; McClelland, A., Jones, S., Tully, G. (2019). *Heritage and community engagement: Collaboration or contestation?* Manchester University Press.

captures through its weighted scoring system[35]. This ensures that each building is evaluated within its own unique cultural and geographical context, rather than imposing a standardized or universal approach.

Hybrid Model: The QAAM integrates both qualitative and quantitative approaches, combining the numerical rigor of scoring with the qualitative insights drawn from tools such as the Heritage Building Inventory Form (HBIF) and the Place Authenticity Matrix (PAM). The HBIF documents the historical, material, and spatial attributes of the building, providing a foundation for the architectural evaluation. The PAM, in contrast, captures the emotional, cultural, and intangible dimensions of the heritage site, offering insights into the social and symbolic significance that the building holds within its community[36]. By merging these two distinct approaches, the QAAM presents a holistic picture of authenticity, bridging the gap between objective assessment and subjective experience.

Scalability: The QAAM is designed to be scalable and applicable across a wide range of global case studies, ensuring that it can be replicated in diverse cultural and geographical contexts without compromising the local nuances. While the core framework of the tool remains consistent, the weighted scoring and criteria can be adjusted to reflect the specific cultural, historical, and environmental factors relevant to each heritage site. This scalability is a key advantage of the QAAM, making it a versatile tool for heritage conservation in both urban and rural settings, and across various regions and time periods[37].

Collaborative Evaluation: To mitigate the potential for individual bias and ensure a more balanced assessment, the QAAM utilizes a consensus scoring approach. A team of multidisciplinary experts, including architects, historians, conservationists, and community representatives, participates in the evaluation process. This collaborative method helps in balancing different perspectives and provides a more nuanced understanding of authenticity of the heritage sites. The consensus approach also promotes inclusivity, allowing for the integration of both professional expertise and local knowledge[38].

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[35]   Cohen, E., Cohen, S. A. (2012). Authentication: Hot and cool. *Annals of Tourism Research,* 39(3), 1295–1314. https://doi.org/10.1016/j.annals.2012.03.004; Kermani, M. (2020). Heritage conservation in rapidly urbanizing contexts: A South Asian perspective. *Journal of Urban Cultural Studies,* 7(2), 189–208. https://doi.org/10.1386/jucs_00025_1

[36]   McClelland, A., Jones, S., Tully, G. (2019). *Heritage and community engagement: Collaboration or contestation?* Manchester University Press.

[37]   Labadi, S. (2010). Preserving cultural heritage for social inclusion: The role of the UNESCO World Heritage Convention. *International Journal of Heritage Studies,* 16(6), 405–422. https://doi.org/10.1080/13527258.2010.505104

[38]   McClelland, A., Jones, S., Tully, G. (2019). *Heritage and community engagement: Collaboration or contestation?* Manchester University Press.

3.2. QAAM Grading System

The QAAM incorporates a structured grading system to quantify the authenticity of heritage buildings based on its four core dimensions. The total possible score for a heritage site using the QAAM framework is 280 points, distributed across the following dimensions:

- Contextual Authenticity: 60 points
- Architectural/Structural Authenticity: 120 points
- Functional/Activity Authenticity: 60 points
- General Perception: 40 points

This grading system is designed with flexibility, allowing for modifications based on specific research objectives or contextual needs (Tab. 1). Based on the total score accumulated across these dimensions, each heritage site is assigned a authenticity value within the following categories:

- Highly Significant Value: 210–280 points
- Significant Value: 140–209 points
- Modest Value: 70–139 points
- No Value: 0–69 points

Quantitative Architecture Authenticity Matrix								
Significance	Degree of Authenticity					Assessment Points		
	Excellent 16-20 points	Very Good 11-15 points	Good 6-10 points	Poor 1-5 points	0 Points	Points Scored	Max.	Descr Min
Contextual Authenticity Setting/ Location							60	15
Harmony and Visual compatibility with surroundings								
Emotional Resonance								
Architectural / Structural Authenticity Architectural Style/ Character							120	30
Structural integrity								
External details/ façade features								
Spatial Layout/ Internal Spaces								
Retention of Facade								
Potential of Reversibility								
Functional / Activity Authenticity Compatibility							60	15
Adaptability								
Retention of Primary Use								
General Perception on Symbolic Value							40	15
Existing Value/ Exceptional Value								
Total points scored							280	75

Tab. 1. Quantitative Architecture Authenticity Matrix

This system allows for a clear and systematic categorization of the value of authenticity of a heritage site, based on both qualitative and quantitative assessments across the four dimensions. The QAAM provides a pilot quantitative assessment tool, and its scoring system can be further refined in future research and applications to allow for more precise evaluations of authenticity, taking into account evolving cultural, historical, and environmental factors.

3.3. Comprehensive Mechanism for Authenticity Assessment

The development of a comprehensive mechanism for assessing authenticity in heritage conservation addresses critical gaps in existing methodologies. This mechanism integrates qualitative and quantitative tools to ensure a holistic evaluation of heritage authenticity, aligning with the principles of contextual objectivity. By combining descriptive assessments with structured metrics, it provides a framework that accommodates diverse cultural, historical, and social contexts. The three core components of this mechanism include the Heritage Building Inventory Form (HBIF), Place Authenticity Matrix (PAM), and Quantitative Architecture Authenticity Matrix (QAAM).

3.3.1. Heritage Building Inventory Form (HBIF)

The HBIF is a comprehensive documentation tool that records detailed information about the physical attributes of the building, including its historical significance, material composition, and architectural design. The form is divided into two parts:

Form A: This section evaluates the heritage status, location, functional attributes, vulnerability, and prior interventions of the building. By capturing the historical, functional, and socio-political significance of the site, Form A provides a detailed contextual understanding of the heritage building (Tab. 2)

Form B: This section focuses on architectural features, elements, materials, and visual documentation. By cataloguing these tangible attributes, Form B ensures that the material integrity of the heritage site is systematically documented (Tab. 3).

The HBIF plays a crucial role in complementing the PAM and QAAM by providing the baseline data needed for comprehensive analysis. Together, these components create a holistic view of the heritage site, forming a robust foundation for conservation planning.

Tab. 2. Heritage Building Inventory Form-A

Tab. 3. Heritage Building Inventory Form-B

3.3.2. Place Authenticity Matrix (PAM)

The Place Authenticity Matrix addresses the qualitative dimensions of authenticity, focusing on intangible values such as emotional resonance, cultural identity, and historical narratives. By capturing the lived experiences and collective memories associated with a heritage site, PAM ensures that the social and cultural significance of the site is not overlooked. PAM relies on descriptive data to map the relationships between individuals and their environments, emphasizing the symbolic and emotional connections that define authenticity of a site. This approach builds upon Balen's[39] the Nara Grid framework, which highlights cultural relativism, and incorporates elements of Heritage Impact Assessment to evaluate the broader implications of conservation interventions on community identity and cultural practices (Tab. 4). By integrating the PAM, the QAAM allows for a more holistic and comprehensive understanding of authenticity, aligning with contemporary conservation principles that emphasize the importance of intangible heritage[40].

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[39]   Van Balen, K. (2008). *Experimenting with the 'NARA-grid', an evaluation scheme based on the Nara Document on Authenticity.* APT Bulletin.
[40]   Avrami, E., Mason, R. (2019). *Values and heritage conservation: A critical approach.* Routledge; Bandarin, F., Van Oers, R. (2012). *The historic urban landscape: Managing heritage in an urban century.* Wiley-Blackwell.

Place Authenticity Matrix		Dimensions			
		Emotional Resonance	Cultural Identity	Physical Manifestation	Community Engagement
Aspects	Historical Narrative				
	Spatial Configuration				
	Symbolic Significance				
	Evolution and Adaptation				

Tab. 4. Place Authenticity Matrix

3.3.3. Qualitative Architecture Authenticity Matrix (QAAM)

The final tool in the QAAM framework is the QAAM Matrix, which synthesizes the various evaluations and converts them into a weighted score that reflects the overall significance of the heritage building. This matrix aggregates the scores from each dimension, architectural/structural authenticity, functional/activity authenticity, contextual authenticity, and general perception, producing a final score that serves as a clear, quantitative measure of authenticity.

The QAAM methodology provides a structured and adaptable approach to assessing authenticity in heritage conservation. By integrating both quantitative metrics and qualitative insights, the tool ensures that the complexities of heritage sites are captured in a manner that is both scientifically rigorous and contextually sensitive. Through its core dimensions, supporting tools, and collaborative evaluation process, the QAAM addresses the gaps in traditional conservation frameworks, offering a more comprehensive and inclusive model for heritage assessment.

4. Research Methodology

In this research, the QAAM as a tool to evaluate authenticity as presented above was pilot-tested and validated through a collaborative online workshop with experts from diverse global regions.

4.1 Research Design and Strategy

The research was conducted in two phases: pre-session preparation and an online workshop. In the pre-session phase, participants received preparatory materials, including the Heritage Building Inventory Form, and guidelines for using the Place Authenticity Matrix (PAM) and Quantitative Architecture Authenticity Matrix (QAAM). These materials ensured consistency in the participants' understanding of the tool while accommodating regional and cultural variations.

Participants selected a heritage building from their region based on its cultural significance, not necessarily its iconic status. They completed the Heritage Building Inventory Form to document the tangible and intangible attributes of the building, such as architectural features, historical narratives, and cultural practices.

The core of the study was the online workshop, where five experts from different regions applied the assessment tool. After an introductory session, participants assessed five buildings from their cultural, regional, and socio-political perspectives, testing the sensitivity of the tool to diverse contextual factors. This collaborative process was grounded in constructivist principles, recognizing authenticity as a context-dependent, co-created construct[41].

4.2 Data Collection Methods and Instruments

Data were collected using a combination of standardized tools and recorded workshop discussions to assess the authenticity of the heritage sites. The Heritage Building Inventory Form (HBIF), Place Authenticity Matrix (PAM), and Quantitative Architecture Authenticity Matrix (QAAM) were the primary instruments for capturing both tangible and intangible aspects of the authenticity of the sites.

In addition to these tools, the online workshop sessions were recorded to gather expert evaluations and feedback. These discussions offered valuable insights into the adaptability and effectiveness of the tools in diverse cultural contexts, contributing to the overall validation of the QAAM framework.

4.3 Selection Criteria and Respondents

To evaluate the effectiveness of the QAAM, a number of internationally recognized heritage sites was chosen, ensuring a broad representation of cultural, historical, and architectural diversity. These sites were selected by the five heritage conservation experts invited to the evaluation workshop, each representing a distinct cultural and regional context. The experts selected the sites based on their cultural and contextual significance, ensuring a range of buildings that reflect diverse challenges in terms of architectural authenticity, functional adaptation, and cultural values. The sites included the Jim Thompson House (Thailand), Massarelos Warehouse (Portugal), Humayun's Tomb (India), and the Shaikh Isa Bin Ali House (Bahrain), among others.

Each of these selected sites presented unique issues related to architectural integrity, adaptive reuse, and cultural relevance, providing a comprehensive basis for evaluating the effectiveness of the matrix. The experts, all of whom have extensive experience in heritage conservation, urban planning, and architecture, were tasked with selecting buildings that went beyond iconic status, focusing instead on those that held intrinsic cultural values and diverse contextual challenges.

4.4 Data Analysis Method

The data were analysed using thematic analysis, well-suited to examining complex, context-dependent phenomena such as authenticity. Transcripts from the recorded sessions were reviewed to identify recurring themes, with the Place Authenticity Matrix (PAM) documenting the cultural and social nuances. Scoring in the Quantitative Architecture Authenticity Matrix (QAAM) was then referenced to evaluate the overall assessment. A comparative analysis was

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[41]   Smith, L. (2006). *Uses of heritage.* Routledge; Guba, E. G., Lincoln, Y. S. (1994). Competing paradigms in qualitative research, [in:] N. K. Denzin, Y. S. Lincoln (Eds.), *The Handbook of Qualitative Research.* SAGE.

conducted to examine the adaptability of the tool across different regions, highlighting its strengths and limitations. Quantitative data from QAAM complemented the qualitative findings, providing a comprehensive evaluation of the performance of the tool.

During the testing process, the QAAM framework was applied to each site using a standardized approach, focusing on the four core dimensions: Architectural/Structural Authenticity, Functional/Activity Authenticity, Contextual Authenticity, and General Perception. Multidisciplinary expert teams, including architects, conservators, historians, and local community members, contributed to the scoring process. These teams conducted a thorough analysis of each site based on the established criteria, assigning scores to each dimension.

The Heritage Building Inventory Form (HBIF) and PAM supported the assessment by documenting both tangible attributes (e.g., materials, design) and intangible factors (e.g., cultural associations, emotional resonance). This combination allowed for a comprehensive understanding of both the physical and symbolic aspects of each heritage site, ensuring that all facets of authenticity were thoroughly considered.

4.5 Ensuring Research Validity

To ensure the validity and reliability of the research, established quality criteria were applied throughout the process. Credibility was achieved through triangulation of data sources, including participant evaluations, the three forms in the framework, and recorded discussions. Inclusion of experts from diverse cultural contexts further enhanced the transferability of the findings, making them applicable across different settings. Dependability was maintained by consistently documenting the research process, ensuring transparency and replicability. Confirmability was achieved by cross-verifying evaluations and minimizing researcher bias, ensuring that the findings reflected the perspectives of the participants.

5. Findings: Testing and Validating QAAM. Insights from International Case Studies on Architectural Authenticity

The QAAM analysis provides nuanced insights into how cultural preferences, architectural styles, and functional perceptions influence the evaluation of authenticity across diverse contexts. Five heritage buildings were evaluated by experts from Portugal, Thailand, Pakistan, India, and Bahrain, revealing significant differences in scoring based on cultural and contextual standpoints. These findings underscore the adaptability of the QAAM in capturing diverse perceptions while maintaining objectivity.

5.1. Massarelos Warehouse, Portugal

Statement of Significance: The old Massarelos Warehouses are part of the industrial and cultural heritage of the city of Porto, listed as 'Building of Public Interest since 1977. It is one of the earlier examples of the School of Porto, the local critical interpretation of Modern Architecture (Fig. 1)

Fig. 1. Massarelos Warehouse Portugal

The evaluations for the Massarelos Warehouse revealed a significant difference in perceptions and preferences for architectural styles (Fig. 2a & 2b). Portuguese assessors awarded the highest score of 216 points, "Highly Significant" (Tab. 5), emphasizing the cultural and architectural significance of the warehouse as part of their national industrial heritage. This score also reflects the prioritization of adaptability and reversibility from a financial perspective, as investment in such typologies aligns with public preferences and economic viability[42].
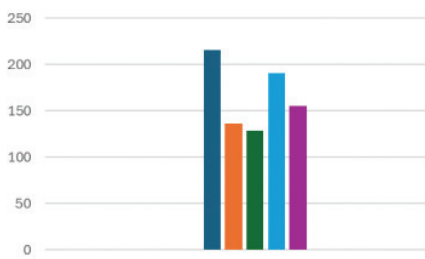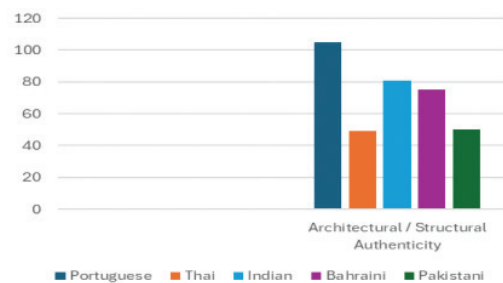

Fig. 2a. Overall Authenticity Evaluation

Fig. 2b. Architectural Authenticity Evaluation

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    42   ICOMOS. (1964). *The Venice Charter: International Charter for the Conservation and Restoration of Monuments and Sites.* https://www.icomos.org/charters/venice_e.pdf

Conversely, Pakistani and Thai assessors rated the warehouse as "Part of Heritage" with 129 and 136 points, respectively, viewing its typology as less relevant in their cultural contexts, where industrial heritage may not hold the same symbolic value. Indian and Bahraini assessors, however, scored it as "Significant" (191 and 155), reflecting a moderate valuation that balances material preservation with potential adaptive reuse. These differences highlight how cultural preferences shape the perception of certain architectural styles and their importance for investment, reinforcing the QAAM's capacity to capture diverse regional priorities.

Quantitative Architecture Authenticity Metrix							
Building Name	Assesor	Contextual Authenticity	Architectural / Structural Authenticity	Functional / Activity Authenticity	General Perception on Authenticity	Total Score	Authenticity Value
Massarelos Warehouse	Portuguese	50	105	27	34	216	Highly significant
	Thai	35	49	32	20	136	Part of Heritage
	Pakistani	34	50	28	17	129	Part of Heritage
	Indian	44	81	35	31	191	Significant
	Bahraini	37	75	25	18	155	Significant

Tab. 5. Quantitative Architecture Authenticity Matrix- Massarelos Warehouse Portugal

5.2. Jim Thompson House, Thailand

Statement of Significance: The Jim Thompson House in Bangkok is a cultural landmark blending traditional Thai architecture with Western influences, reflecting the legacy of Jim Thompson, an American businessman who revitalized the Thai silk industry (Fig. 3)

Fig. 3. Jim Thompson House, Thailand

This site exemplifies the role of contextual authenticity in shaping evaluations. Pakistani and Indian assessors rated the house as "Highly Significant" with 262 and 261 points, respectively, emphasizing its architectural hybridity and symbolic resonance as a heritage asset within an urbanized setting (Fig. 4a & 4b). However, Thai and Bahraini assessors provided lower scores 198 and 173, "Significant", reflecting skepticism regarding its location within a business district, which some cultures perceive as diminishing the heritage value of such buildings[43].
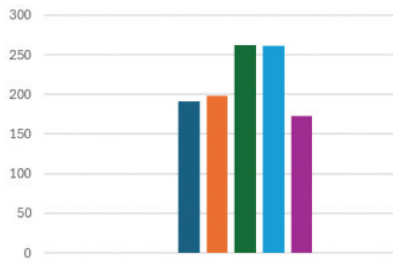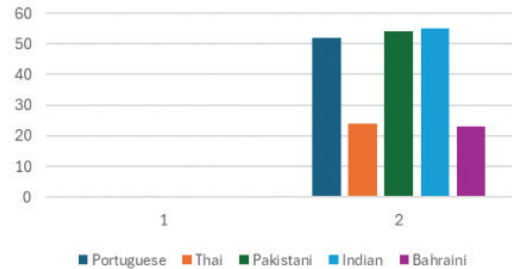

Fig. 4a. Overall Authenticity Evaluation

Fig. 4b. Contextual Authenticity Evaluation

The Portuguese assessor, who scored it as 191 points "Significant), struck a balance by valuing its architectural integrity while acknowledging the contextual challenges posed by its urban setting (Tab. 6). These findings demonstrate how the cultural preferences regarding the location of heritage buildings influence their perceived value, emphasizing the need for adaptable evaluation tools like QAAM to account for such differences[44].

Quantitative Architecture Authenticity Metrix							
Building Name	Assesor	Contextual Authenticity	Architectural / Structural Authenticity	Functional / Activity Authenticity	General Perception on Authenticity	Total Score	Authenticity Value
Jim Thompson House	Portuguese	52	76	33	30	191	Significant
	Thai	24	108	46	20	198	Significant
	Pakistani	54	112	58	38	262	Highly significant
	Indian	55	110	57	39	261	Highly significant
	Bahraini	23	95	25	30	173	Significant

Fig. 6. Quantitative Architecture Authenticity Matrix- Jim Thompson House, Thailand

5.3. Shams Building, Pakistan

Statement of Significance: The Shams building is a colonial listed building. Its architectural ornamentation remains well-preserved and meticulously maintained. Currently, only the top additional floor serves as a residential space, while the rest of the building functions as an undergarment warehouse (Fig. 5)

43   Jokilehto, J. (2006). *A history of architectural conservation* (2nd ed.). Routledge.
44   Schultz, J. (1980). *Place and identity: Interpretations of locality in heritage contexts.* Heritage Press.

Fig. 5. Shams Building, Pakistan

The evaluations for the Shams Building underscore the influence of architectural/structural authenticity on scoring. Pakistani and Portuguese assessors rated the building as "Significant" with 191 and 209 points, emphasizing its colonial architectural style, which holds historical value in post-colonial contexts (Fig. 6a & 6b). However, Thai and Bahraini assessors scored it lower as 137 and 169 points, reflecting cultural perceptions where such architectural styles are considered common and, therefore, less significant. The Indian assessor, who scored it as 182 points "Significant" (Tab. 7), highlighted the importance of reversibility in old residential buildings, aligning with conservation principles that prioritize adaptability while preserving material authenticity[45]. This case illustrates how colonial architectural styles can evoke differing perceptions of significance, depending on their prevalence and symbolic meaning in specific cultural contexts.

Quantitative Architecture Authenticity Metrix							
Building Name	Assesor	Contextual Authenticity	Architectural / Structural Authenticity	Functional / Activity Authenticity	General Perception on Authenticity	Total Score	Authenticity Value
Shams Building	Portuguese	46	82	46	35	209	Significant
	Thai	42	45	35	15	137	Part of Heritage
	Pakistani	42	85	40	24	191	Significant
	Indian	35	81	42	24	182	Significant
	Bahraini	34	65	32	38	169	Significant

Tab. 7. Quantitative Architecture Authenticity Matrix- Shams Building, Pakistan

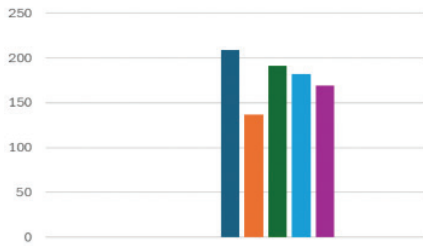45   Cohen, E., Cohen, S. A. (2012). Authentication: Hot and cool. *Annals of Tourism Research,* 39(3), 1295–1314. https://doi.org/10.1016/j.annals.2012.03.004
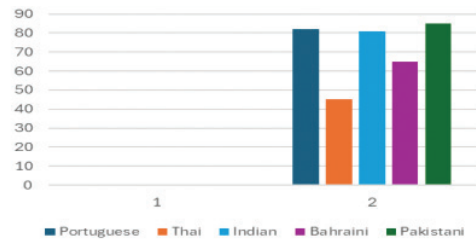
Fig. 6a. Overall Authenticity Evaluation

Fig. 6b. Contextual Authenticity Evaluation

5.4. Tomb of Emperor Humayun, India

Statement of Significance: Built in 1570, this Mughal architecture tomb holds immense cultural significance as the first garden-tomb on the Indian subcontinent. It marked the beginning of a new architectural era, inspiring several iconic innovations that ultimately culminated in the construction of the Taj Mahal (Fig. 7)
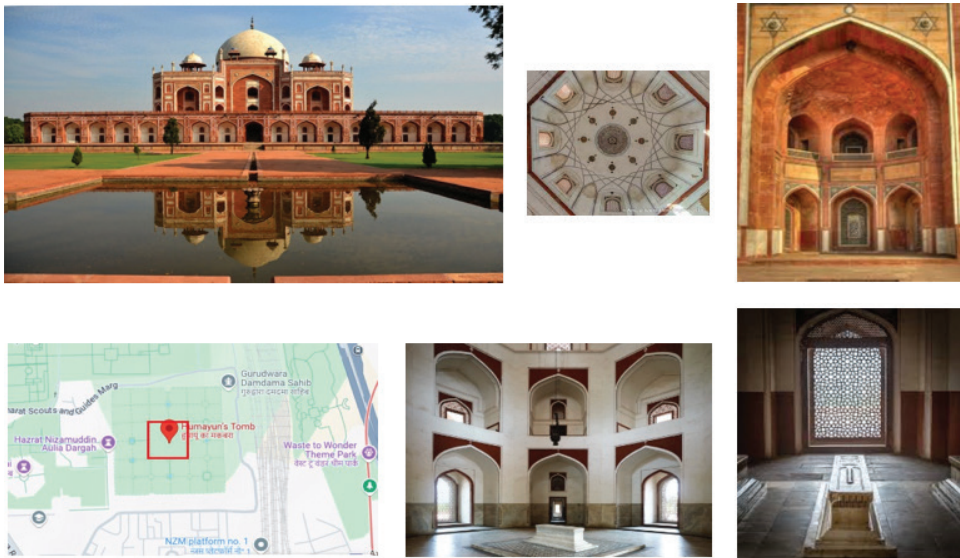

Fig. 7. Tomb of Emperor Humayun, India

The Tomb of Emperor Humayun revealed divergent evaluations influenced by contextual authenticity and general perception. Portuguese, Thai, and Pakistani assessors uniformly rated it as "Highly Significant" with 268 and 263 points (Fig. 8a & 8b), emphasizing its architectural grandeur, religious symbolism, and role as a cultural landmark. These scores align with global recognition of its historical and spiritual significance[46]. However, Indian and Bahraini assessors, while recognizing its importance, rated it as "Significant" 200 points (Tab. 8), reflecting localized perceptions of reverence and symbolic value (Figure 8b).

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[46]   Labadi, S. (2010). Preserving cultural heritage for social inclusion: The role of the UNESCO World Heritage Convention. *International Journal of Heritage Studies,* 16(6), 405–422. https://doi.org/10.1080/13527258.2010.505104
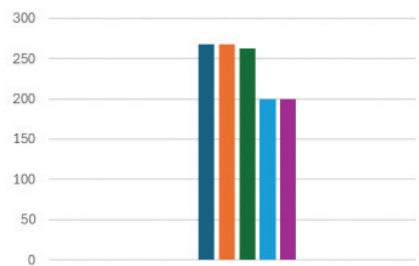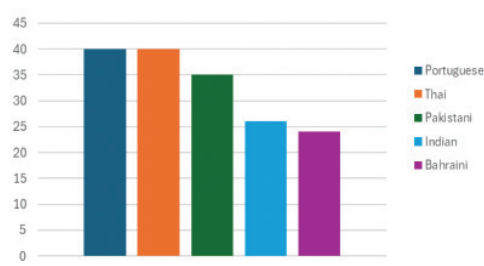
Fig. 8a. Overall Authenticity Evaluation

Fig. 8b. General Perception of Authenticity Evaluation

The Indian score, in particular, reflects a balance between its monumental status and its integration into contemporary cultural practices. These differences highlight how cultural and religious diversity shapes the perception of context and reverence for heritage sites, reinforcing the need for tools that integrate both tangible and intangible dimensions of authenticity[47].

Quantitative Architecture Authenticity Metrix							
Building Name	Assesor	Contextual Authenticity	Architectural / Structural Authenticity	Functional / Activity Authenticity	General Perception on Authenticity	Total Score	Authenticity Value
Humayon Tomb	Portuguese	60	116	52	40	268	Highly significant
	Thai	60	114	54	40	268	Highly significant
	Pakistani	54	113	58	38	263	Highly significant
	Indian	51	90	33	26	200	Significant
	Bahraini	40	97	33	30	200	Significant

Fig. 8. Quantitative Architecture Authenticity Matrix- Shams Building, Pakistan

5.5. *Shaikh Isa Bin Ali House, Bahrain*

Statement of Significance: The Shaikh Isa bin Ali House is considered one of the finest examples of traditional Gulf urbanization. It is among the oldest houses in Bahrain, built using local materials and traditional construction techniques. It is designated as a UNESCO World Heritage Site in Bahrain. (Fig. 9)

47   Kermani, M. (2020). Heritage conservation in rapidly urbanizing contexts: A South Asian perspective. *Journal of Urban Cultural Studies,* 7(2), 189–208. https://doi.org/10.1386/jucs_00025_1

Fig. 9. Shaikh Isa Bin Ali House, Bahrain

The evaluations of the Shaikh Isa Bin Ali House highlighted differences in perceptions of functional authenticity and adaptability. All assessors uniformly rated it as "Highly Significant", with scores ranging from 217 to 245. However, the underlying factors influencing these scores varied (Figure 10a &10b)
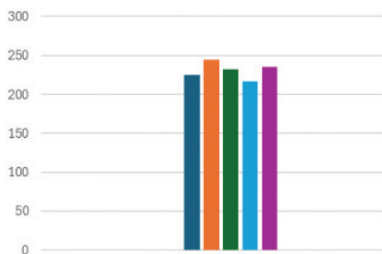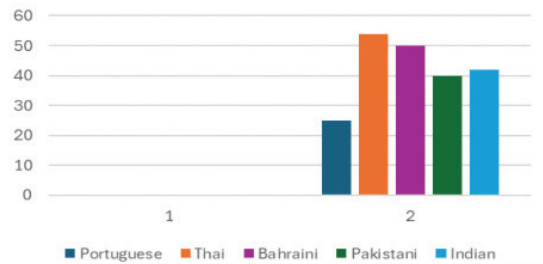

Fig. 10a. Overall Authenticity Evaluation

Fig. 10b. General Perception of Authenticity Evaluation

Thai and Pakistani assessors emphasized its adaptability for modern uses, reflecting the value placed on functional transformation in their cultural contexts. In contrast, Portuguese and Bahraini assessors focused on its architectural preservation and cultural symbolism, highlighting its role as a representation of regional identity[48]. These findings underscore how perceptions of functional adaptability differ across cultures, influencing the prioritization of interventions and conservation strategies (Tab. 9)

The QAAM's ability to integrate these diverse assessments demonstrates its robustness and adaptability, offering a scalable tool for heritage conservation that respects both global standards and regional nuances. Its emphasis on contextual objectivity ensures that authenticity assessments remain inclusive, dynamic, and reflective of the socio-cultural dimensions of heritage sites.

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[48] Avrami, E., Mason, R. (2019). *Values and heritage conservation: A critical approach*. Routledge.

Quantitative Architecture Authenticity Metrix							
Building Name	Assesor	Contextual Authenticity	Architectural / Structural Authenticity	Functional / Activity Authenticity	General Perception on Authenticity	Total Score	Authenticity Value
Sh. Isa Bin Ali House	Portuguese	55	105	25	40	225	Highly significant
	Thai	56	115	54	20	245	Highly significant
	Pakistani	52	106	40	34	232	Highly significant
	Indian	54	88	42	33	217	Highly significant
	Bahraini	49	100	50	36	235	Highly significant

Tab. 9. Quantitative Architecture Authenticity Matrix- Shams Building, Pakistan

6. QAAM Results and Framework Evaluation

The testing phase of the Quantitative Architecture Authenticity Matrix (QAAM) re-affirmed its strong ability to assess authenticity across diverse cultural, architectural, and functional contexts. This section highlights the points of diversity in assessment, evaluates the effectiveness of the framework, and identifies opportunities for improvement.

6.1. Points of Diversity in Authenticity Assessment

The application of QAAM in these case studies demonstrated the pivotal role of cultural preferences, religious values, and contextual interpretations in shaping authenticity assessments. For instance, Portuguese assessors emphasized material and architectural integrity in evaluating sites like the Massarelos Warehouse, reflecting a European inclination toward industrial heritage conservation. In contrast, South Asian assessors from India and Pakistan attributed greater importance to colonial-era architecture for its historical narratives and symbolic associations[49].

Religious affiliations also influenced assessments—particularly evident in evaluations of Humayun's Tomb, where Pakistani and Indian participants highlighted its spiritual and historical significance. Bahraini and Portuguese assessors, however, focused more on its architectural features. These culturally varied interpretations align with the *Nara Document*[50], which emphasizes cultural relativism and the need to recognize intangible heritage in authenticity evaluations.

By accommodating these diverse perspectives, the QAAM proves highly responsive to local values and socio-cultural lenses, making it a suitable tool for use in global contexts[51].

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[49]   Jokilehto, J. (2006). *A history of architectural conservation* (2nd ed.). Routledge; González Martínez, A. (2017). Contextual objectivity in heritage conservation: A tool for inclusive narratives. *International Journal of Heritage Studies,* 23(5), 425–437. https://doi.org/10.1080/13527258.2016.1277772

[50]   ICOMOS. (1994). *The Nara Document on Authenticity*. https://www.icomos.org/charters/nara-e.pdf

[51]   Labadi, S. (2010). Preserving cultural heritage for social inclusion: The role of the UNESCO World Heritage Convention. *International Journal of Heritage Studies,* 16(6), 405–422. https://doi.org/10.1080/13527258.2010.505104; Kermani, M. (2020). Heritage conservation in rapidly urbanizing contexts: A South Asian perspective. J*ournal of Urban Cultural Studies*, 7(2), 189–208. https://doi.org/10.1386/jucs_00025_1

6.2. Evaluation and Strengths of the Framework

The QAAM's structured framework—covering four core dimensions: Contextual Authenticity, Architectural/Structural Authenticity, Functional/Activity Authenticity, and General Perception—enabled a comprehensive and replicable evaluation process. Sites such as the Jim Thompson House (Thailand) and Shams Building (Pakistan) revealed how architectural styles, urban setting, and historical narratives significantly influence perceptions of authenticity.

Its key strength lies in integrating quantitative scoring with cultural sensitivity, ensuring that both tangible and intangible values are addressed. For example, the high score assigned to the Shaikh Isa Bin Ali House reflected both its architectural integrity and deep-rooted community significance, while the mixed evaluations of Humayun's Tomb illustrated the matrix's ability to register differences in religious and cultural interpretations.

The framework supports participatory conservation, allowing experts and local stakeholders alike to inform the evaluation. This inclusivity enhances both the legitimacy and cultural relevance of the assessments, echoing the participatory goals outlined in the *Burra Charter*[52] and related global conservation principles.

Theme	Heritage Building Inventory Form (HBIF)	Place Authenticity Matrix (PAM)	Quantitative Architecture Authenticity Matrix (QAAM)
Documentation Focus	Provides detailed documentation of physical attributes and functional context, including historical and material data.	Emphasizes intangible values such as cultural identity, emotional resonance, and collective memory.	Combines quantitative metrics with cultural preferences, accounting for architectural styles and functional adaptability.
Cultural Sensitivity	Limited to tangible heritage, requiring complementary tools to address cultural and contextual variations.	Strongly integrates cultural relativism, emphasizing symbolic and social dimensions of heritage.	Effectively balances global standards with regional nuances, accommodating diverse cultural, religious, and contextual values.
Assessment Scope	Primarily captures physical and architectural elements, forming the baseline for further evaluations.	Focuses on intangible heritage dimensions, offering rich narrative-driven insights into place identity.	Integrates tangible and intangible factors through structured metrics, enhancing replicability and scalability.

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52   ICOMOS Australia. (1999). *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance*. https://australia.icomos.org/publications/charters/

Objectivity	Presents an objective, data driver analysis of tangible elements, while also documenting historical significance.	Qualitative and narrative-driven, emphasizing subjective community perspectives.	Introduces a quantitative contextual objectivity, relying on collective and consensus based weighted scoring for reversibility, cultural preferences, and architectural integrity, enhancing objectivity.
Community Engagement	Indirectly supports engagement through comprehensive documentation but lacks explicit participatory mechanisms.	Strongly relies on participatory methods to capture community narratives and emotional connections.	Balances expert-driven assessments with potential for community-informed weightage adjustments.
Application Context	Foundational tool applicable to diverse heritage types; requires integration with PAM and QAAM for holistic assessment.	Best suited for sites with rich intangible heritage or strong community ties.	Versatile across global and regional contexts, evidenced by testing results showing adaptability to cultural and religious influences.
Testing Insights	Lays groundwork for QAAM and PAM by systematically documenting baseline heritage data.	Enhances QAAM results by enriching qualitative dimensions, addressing gaps in material-focused approaches.	Testing results reveal its robustness in capturing diverse perceptions, highlighting cultural, architectural, and contextual differences.
Adaptability & Improvement	Requires enhancements to integrate adaptive reuse and evolving functionality into assessments.	Could incorporate structured participatory tools, such as oral histories or participatory mapping.	Would benefit from participatory weighting mechanisms to integrate non-expert perspectives alongside expert evaluations.

Tab. 10. Cross Comparison Analysis of Assessment tools Documenting Usability and Relevance

6.3 Factors for Improvement

Despite its strengths, several aspects of the QAAM could benefit from refinement:

• General Perception remains the most subjective dimension. While consensus scoring helped reduce individual bias, clearer guidelines and standardized weighting could improve consistency across different cultural contexts.

• The evaluation of adaptive reuse scenarios, particularly for multi-functional or evolving heritage sites (e.g., Massarelos Warehouse), requires more robust criteria to balance historical value with contemporary utility.

• Stakeholder feedback emphasized the need for greater community participation in defining authenticity. Structured mechanisms such as workshops, surveys, and localized scoring adjustments would better integrate community knowledge and social meaning into the framework[53].

• The inclusion of additional socio-religious and economic metrics could enhance the ability of the QAAM to capture complex heritage values—especially in regions where cultural practices are closely tied to spiritual and communal traditions.

6.4 Summary of Effectiveness

Overall, this research has demonstrated the potential of QAAM as a flexible, inclusive, and culturally responsive tool for the assessment of authenticity. It effectively bridges the divide between traditional material-based evaluation and the broader, dynamic values of place identity, cultural continuity, and community engagement.

Its successful pilot implementation shows that it can be adapted to various heritage types and regional contexts, supporting more informed and equitable conservation practices. With further refinement, particularly around standardization and participatory integration, QAAM could emerge as a globally recognized framework for assessing heritage authenticity in a sustainable and culturally meaningful way.

Conclusion and Way Forward

The Quantitative Architecture Authenticity Matrix (QAAM) represents a meaningful advancement in heritage conservation, bridging the gap between qualitative interpretation and quantitative rigor. Unlike traditional models that often emphasize either material preservation or intangible cultural values in isolation, QAAM offers a holistic approach by integrating architectural, contextual, functional, and perceptual dimensions into a unified framework.

This research through pilot testing revealed a notable strength of QAAM in contextual adaptability, allowing it to respond effectively to diverse cultural, historical, and socio-political settings. This flexibility enhances its relevance across a wide range of heritage sites and fosters broader stakeholder engagement—from heritage professionals to local communities.

This research also confirmed the potential of the QAAM in capturing both tangible and intangible values while also identifying areas for further refinement:

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53   Schultz, J. (1980). *Place and identity: Interpretations of locality in heritage contexts.* Heritage Press; McClelland, A., Jones, S., Tully, G. (2019). *Heritage and community engagement: Collaboration or contestation?* Manchester University Press.

- **General Perception** scoring requires clearer guidelines to reduce subjectivity and improve consistency.

- **Adaptive reuse scenarios** would benefit from standardized evaluation criteria, especially in buildings with evolving functions.

- **Community-driven input mechanisms**, such as participatory workshops or localized scoring, should be introduced to strengthen inclusivity and cultural representation.

Although the pilot study faced limitations, including a small sample size and uneven regional representation, it nonetheless affirmed the promise of QAAM as a globally adaptable tool. Continued development through iterative testing, expanded stakeholder participation, and interdisciplinary collaboration will enhance its applicability and precision.

Looking forward, expanding the framework to address additional factors—such as architectural nomenclature, socio-economic viability, and socio-religious significance—will further align QAAM with the goals of sustainable development and inclusive heritage governance.

Finally, while still evolving, the QAAM lays a solid foundation for redefining authenticity assessments. By uniting measurable metrics with cultural nuance, it offers a flexible, scalable model that reflects the dynamic realities of contemporary heritage practice. With ongoing refinement and engagement, QAAM can serve as a vital tool in safeguarding heritage as a living and inclusive expression of global cultural identity.

Authors' contributions

AAS collected and analysed the data and wrote the manuscript as part of the requirements of her PhD. DPC and AN supervised the research and provided feedback to improve manuscript.

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