

# Computation of heritage values: Towards a holistic method to assess built heritage

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## Abstract

The objective of this paper is to put forward a holistic, less subjective, method to value built heritage. Based on 37 seminal publications issued from 1903 to date, 24 value typologies were identified, classified and incorporated in a heritage value grid developed from the Nara Grid. This grid allows for a multi-layered valorization of aesthetic, socio-cultural, economic and informational values with respect to six heritage dimensions, namely, (i) design, (ii) materiality, (iii) function, (iv) location, (v) tradition and techniques, and (vi) spirit and memory. This formed the basis of a mathematical formula, the Heritage Value Calculation, to compute the heritage value of a given building. The resulting final value is useful in the scheduling of such sites.

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## 1. Introduction

The notion of values is in a continuous state of flux. Value assessment methods in contemporary conservation theory face challenges to account for consideration of divergent value systems and ethnographic traditions. Furthermore, decision-making in conservation relies on the understanding of heritage values and the association society has with specific places and spaces:

*“Concepts of value directly shape modes of practice, so new notions of value inspire new practices. Further, the complex relationships between traditional heritage values and broader societal values raise questions about their application in decision-making processes” [1].*

In recent years, some scholars adopted a mathematical approach to quantify built heritage. Segments of Multicriteria Decision Analysis have been applied to assess the reuse of historic buildings [2], in risk analysis of World Heritage Sites [3], to assess the value of a particular heritage sector (in this case, industrial heritage) [4] and for geoheritage appraisal [5]. Based on research undertaken by one of the authors [6], which included a review of the main literature on conservation theory, this paper attempts to generate a formula to compute the value of a given heritage site based on a set of criteria established through a value grid. Dimensions of heritage and value typologies identified from the existing corpus of literature on heritage conservation form the basis of this grid.

## 2. Heritage values

Jokilhto [7] explores the evolution of heritage values from antiquity to the twentieth century. Whilst education and culture were core values in antiquity around the Mediterranean, politics and economy were more pertinent tenets of those societies. Following the emerging historical and artistic values during the Italian Renaissance,

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an array of ideals – including educational, socio-political and economic values – began to be attributed to built heritage. Use and spiritual values are at the foreground of contemporary conservation discourse [8]. Feilden [9] categorizes heritage values under three headings: (i) emotional (a: wonder; b: identity; c: continuity; d: spiritual and symbolic), cultural (a: documentary; b: historic; c: archaeological age and scarcity; d: aesthetic and symbolic, e: architectural, f: townscape, landscape and ecological; g: scientific), and use (a: functional; b: economic; c: societal; d: political).

Values frequently discussed include the following: cultural/symbolic, spiritual/religious, historic and age, typological, aesthetic, architectural, structural, constructional, evidential, use/functional, social, and economic (market). Cultural/symbolic value comprises the representative value that a society gives to a place or monument when identifying it in the context of specific historical events, people or tangible/intangible social connotations (Figure 1). Such values are ingrained within communities and are passed down through generations, often varying with time [10]. Spiritual/religious value emerges from societal traditions, beliefs and teachings regarding organized religion (Figure 2) [11]. Historic and age value grounds the notion of heritage and can be manifested in several ways, from a site's rarity and archival potential to its societal associations and the heritage material's age (Figure 3). Educational and artistic values are two important subtypes of this typology [11]. Typological value is derived from the building type and its context. Features of places which hosted identical functions may vary according to geographic location, historic period and cultural requirements. This value is associated with other spatial, environmental and visual relationships [10]. Aesthetic value is assigned to a place when it incites sensory and intellectual stimulation due to conscious design and artistic endeavor [12]. Aesthetic appeal may also be based on context, form and proportions, as well as the observer's own experiential 'baggage' [13]. Architectural value is when form, proportion, scale and rhythm are employed together with ornamentation and decoration to convey the intended function of a building, as well as cultural associations about who built it and/or when and where it was built (Figure 4) [10]. A place is of structural value when its structural system contains historic "information on the technical knowledge of past societies", materials and context (Figure 5). Structural systems often indicate specific construction time periods and past skills and techniques [10]. Directly related is construction value; this may vary depending on the context, as it is linked to the availability of local resources (Figure 6). Different cultures have developed various structural systems using the same materials and construction techniques [10]. Evidential value is when the place bears witness to past anthropological activity or provides physical inherited traits (Figure 7). This allows better understanding of the past when the written or material record is scarce [12]. Function is a fundamental quality of architecture and this may undergo transformation or perish with time. Use value is assigned to heritage objects whose function is relevant today (Figure 8). When the function of a heritage building is transformed or ceases to be, suitable adaptive reuse is one solution [10]. A social value is assigned to a place that is shared amongst the community, bringing a sense of identity, converting menial daily activities to collective celebrations. A place bearing social value is one that creates social cohesion, facilitates social interactions and generates a strong 'place attachment' [9]. The economic (market) value is an influential element of how society assesses a heritage asset. It overlaps with sociocultural and use values [11].

### 3. Computing heritage value

#### 3.1 Heritage value typologies

Research compiled by Mason [13], Yung and Chan [14], de la Torre [11], Doğan [15], Chen and Li [16] and Olukoya [17] formed the basis for Table 1. In this quantitative overview, 37 leading sources from the turn of the twentieth century were classified in terms of the following value typologies: 1) spiritual/religious, 2) cultural/symbolic, 3) social/community, 4) political, 5) anthropological (archaeological and environmental), 6) typological/townscape, 7) contextual, 8) historic, 9) rarity, 10) prestige/legacy, 11) commemorative, 12) aesthetic/artistic, 13) architectural, 14) scientific/structural, 15) technical/constructional, 16) economic, 17) option, 18) use, 19) tourism, 20) evidential, 21) educational, 22) newness, 23) ecological/landscape, and 24) authenticity. These typologies are the baseline for a system which assesses the significance of a heritage site. The prevalence of heritage values was computed through the summation of those referred to in a given publication and were classified for ease of reference in terms of the following:

- Reference count/s: 1–8 (least prevalent)
- Reference counts: 9–17
- Reference counts: 18–26 (most prevalent)



Figure 1. The Colosseum (Rome, Italy)  
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Figure 2. Zograf Monastery (Mount Athos, Greece)  
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Figure 3. Hagar Qim (Qrendi, Malta)  
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Figure 4. Parliament building (Budapest, Hungary)  
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Figure 5. Casa Ippolito (Birżebbuġa, Malta)  
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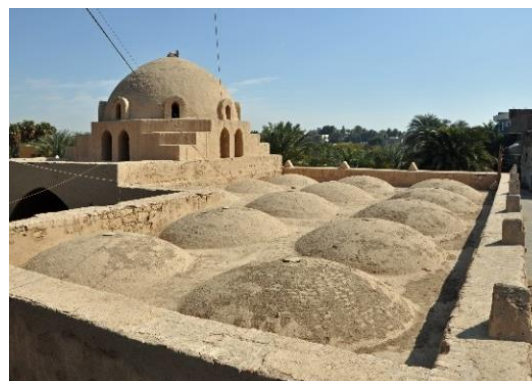


Figure 6. Gurna Mosque (Luxor, Egypt)  
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Figure 7. Giuseppe Antonini Psychiatric Hospital (Mombello, Italy)  
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Figure 8. National Library (Valletta, Malta)  
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Table 1. Value typologies included in seminal publications from the turn of the twentieth century

Author	Value Typologies											
	1	2	3	4	5	6	7	8	9	10	11	12
Riegl [18]								x			x	
Athens Charter [19]								x				x
Venice Charter [20]					x			x				x
Amsterdam Declaration [21]		x	x					x			x	
Antiquities Advisory Board [22]			x					x	x			
Kalman [23]								x				
Feilden [9]	x	x	x	x	x	x		x				x
Lipe [24]		x										x
Nara Document [25]		x	x					x				x
Darvill and Wainwright [26]		x	x		x							
San Antonio Declaration [27]		x	x					x				
Carver [28]			x	x	x							
Frey [29]										x		
English Heritage [30]		x										x
Ashley-Smith [31]		x	x									
Australia ICOMOS [32]	x	x	x	x				x		x		x
Kerr [33]		x	x					x	x			x
Throsby [34]	x	x	x					x				x
Pye [35]		x					x	x				x
Mason [13]	x	x	x					x		x		x
Antiquities and Monuments Office [36]		x						x				x
Faro Charter [37]		x						x		x		
Keene [38]	x	x	x					x				x
Appelbaum [39]			x					x	x		x	x
Roders [40]			x	x				x				x
English Heritage [12]			x					x				x
Quebec Declaration [41]	x	x	x	x				x				x
FHBRO [42]								x				
Orbaşlı [43]	x	x	x	x		x		x	x			x
Stubbs [44]		x								x		x
Robles [45]		x				x		x				x
ICOMOS New Zealand [46]	x	x	x		x			x		x	x	x
Szmelter [47]		x	x	x					x			x
Lertcharnrit [48]		x										
Yung and Chan [49]			x	x	x	x	x					
Gielen, et al. [50]			x		x							
UNESCO World Heritage Committee [51]	x	x			x			x		x	x	x
Reference Count	9	24	22	8	8	4	2	26	5	7	5	23

Table 1 (cont.). Value typologies included in seminal publications from the turn of the twentieth century

Author	Value Typologies											
	13	14	15	16	17	18	19	20	21	22	23	24
Riegl [18]						x				x		
Athens Charter [19]	x											
Venice Charter [20]	x											
Amsterdam Declaration [21]												
Antiquities Advisory Board [22]	x											
Kalman [23]	x					x					x	
Feilden [9]	x	x	x	x		x		x	x		x	
Lipe [24]				x				x				
Nara Document [25]		x										x
Darvill and Wainwright [26]		x		x	x	x			x			
San Antonio Declaration [27]				x				x				
Carver [28]				x								
Frey [29]				x	x			x	x			
English Heritage [30]				x		x			x			
Ashley-Smith [31]				x	x			x				
Australia ICOMOS [32]		x										
Kerr [33]			x						x			
Throsby [34]												x
Pye [35]		x		x								
Mason [13]				x	x	x		x				
Antiquities and Monuments Office [36]	x				x			x	x			
Faro Charter ([37]				x								
Keene [38]												x
Appelbaum [39]				x		x		x	x	x		
Roders [40]		x		x							x	
English Heritage [12]								x				
Quebec Declaration [41]											x	
FHBRO [42]	x										x	
Orbaşlı [43]	x	x	x	x				x	x		x	
Stubbs [44]						x						
Robles [45]	x	x	x			x						
ICOMOS New Zealand [46]	x	x	x			x					x	
Szmelter [47]			x	x		x	x	x	x			
Lertcharnrit [48]				x		x		x	x			
Yung and Chan [49]				x			x					
Gielen, et al. [50]				x								
UNESCO World Heritage Committee [51]		x	x									
Reference Count	10	10	7	18	5	12	2	12	10	2	7	3

### 3.2 Developing a heritage value grid

The heritage value typologies have been categorized in terms of (i) form and physicality, (ii) socio-cultural, (iii) economic and use and (iv) informational values (Table 2). These categories are congruent with those of Lipe [24], namely, aesthetic, associative/symbolic, economic and informational values. The proposed heritage value criteria are further subdivided based on the reference counts included in Table 1.

Table 2. Heritage value criteria (for color coding refer to legend in section 3.1)

Form and Physicality	Socio-Cultural	Economic and Use	Informational
Aesthetic/Artistic	Cultural/Symbolic	Economic	Historic
Architectural	Social/Community	Use	Scientific/Structural
Typological	Spiritual/Religious	Option	Evidential
Contextual	Political	Tourism	Educational
Rarity	Anthropological		Technical/Constructional
Newness	Prestige/Legacy		Ecological/Landscape
Authenticity	Commemorative		

Drafted to address the shortcomings of the Venice Charter [20], The Nara Document on Authenticity [25] reinforces the notion of cultural relativism, invalidating the supremacy of the three-decade old charter and distancing itself from a material-oriented definition of heritage [52]. According to the charter, authenticity may be linked with several sources. It states that:

*“Aspects of the sources may include form and design, materials and substance, use and function, traditions and techniques, location and setting, and spirit and feeling, and other internal and external factors”* [25].

The Nara Grid, which is based on the Nara Document on Authenticity, is a checklist to facilitate the identification of all aspects relating to the valuation of cultural heritage [53] where dimensions of heritage are tabulated versus aspects of heritage. This grid was used to develop a heritage value grid to analyze and achieve a qualitative measure of the multifaceted notion of authenticity. The authors developed a new approach inspired from the Nara Grid whereby heritage value criteria included in Table 2 are tabulated versus the following six heritage dimensions: design, materiality, function, location and context, tradition and techniques, and spirit and memory (Table 3). The first four are static (tangible and intangible aspects of heritage) whilst the remaining are dynamic (intangible aspects of heritage) dimensions. In this way, a multi-layered qualitative assessment and valorization of a given heritage site was established, enabling a less subjective scheduling process. This proposed grid facilitates a system of understanding how different value criteria impact each dimension of a heritage site, leading to an optimized approach towards value apportionment and a more holistic examination of a given heritage asset. Each value criterion will be cross-referenced with the six dimensions of heritage, resulting in 144 value combinations for a given heritage site.

Table 3. Heritage value grid

Dimensions		Values			
		Form and Physicality	Socio-Cultural	Economic and Use	Informational
Static	Design				
	Materiality				
	Function				
	Location and Context				
Dynamic	Tradition and Techniques				
	Spirit and Memory				

### 3.3 Heritage value calculation

The authors adopted a scoring system which distributes equal weighting to all heritage value typologies. Furthermore, the scoring system applied assigns equal weighting to each value criterion included in Table 1 and

dimensions of heritage and heritage value included in Table 3. Assuming a dimension of heritage for a given heritage site, the average within ( $z_i^k$ ), the value category for each dimension, is calculated thus:

$$z_i^k = \frac{1}{M_i} \sum_{j=1}^{M_i} x_{ij}$$

where, with reference to Table 2,  $M_1 = 7, M_2 = 7, M_3 = 4, M_4 = 6$ , representing form and physicality (7 in number), socio-cultural (7 in number), economic and use (4 in number), and informational (6 in number) values, respectively. This ensures equal weighting for a criterion within the four categories. The heritage value criteria indicating the average within ( $z_i^k$ ), say for the ‘design’ dimension of heritage (Table 3), is given in Table 4.

Table 4. Heritage value criteria indicating the average within ( $z_i^k$ )

Form and Physicality	Socio-Cultural	Economic and Use	Informational
$x_{11}$	$x_{21}$	$x_{31}$	$x_{41}$
$x_{12}$	$x_{22}$	$x_{32}$	$x_{42}$
$x_{13}$	$x_{23}$	$x_{33}$	$x_{43}$
$x_{14}$	$x_{24}$	$x_{34}$	$x_{44}$
$x_{15}$	$x_{25}$		$x_{45}$
$x_{16}$	$x_{26}$		$x_{46}$
$x_{17}$	$x_{27}$		
$z_1^1$	$z_2^1$	$z_3^1$	$z_4^1$

The outer average ( $y_k$ ) of a given heritage dimension is calculated thus:

$$y_k = \frac{1}{N} \sum_{i=1}^N z_i^k$$

where  $N = 4$ , for the four heritage value categories. The value criteria indicating the average outer, say for the ‘design’ dimension of heritage (Table 3), is given in Table 5 (highlighted row corresponds to the one shown in Table 4). Once the outer average ( $y_k$ ) for a given heritage dimension is calculated ( $y_1$  to  $y_6$ , corresponding to the six heritage dimensions), then the final value ( $F$ ) of the Heritage Value Calculation is given by:

$$F = \frac{1}{K} \sum_{k=1}^K y_k$$

where  $K = 6$ , for the six dimensions of heritage. This ensures that all the dimensions of heritage have equal weighting. Thus,  $z, y$  and  $F$  ensure equal weighting to all values, to all value categories and to all heritage dimensions, respectively. For a given heritage site,  $0 \leq F \leq 1$ ; the closer the value is to 1, the more valuable the site.

Table 5. Heritage value grid indicating the average outer ( $y_k$ ) and final value ( $F$ )

Dimensions of Heritage	Heritage Value				$y_k$
	Form and Physicality	Socio-Cultural	Economic and Use	Informational	
Design	$z_1^1$	$z_2^1$	$z_3^1$	$z_4^1$	$y_1$
Materiality	$z_1^2$	$z_2^2$	$z_3^2$	$z_4^2$	$y_2$
Function	$z_1^3$	$z_2^3$	$z_3^3$	$z_4^3$	$y_3$
Location and Context	$z_1^4$	$z_2^4$	$z_3^4$	$z_4^4$	$y_4$
Tradition and Techniques	$z_1^5$	$z_2^5$	$z_3^5$	$z_4^5$	$y_5$
Spirit and Memory	$z_1^6$	$z_2^6$	$z_3^6$	$z_4^6$	$y_6$
Final Value					$F$

#### 4 Final comments

The Heritage Value Calculation is a mathematical, multicriteria computation which allows for binary and non-binary valuation of built heritage. In computing the heritage value through this method, all values, categories and dimensions, are assumed to have equal weighting. It is recommended that this process is carried out thematically, for example, for a given typology over a given time period. For a large sample of heritage buildings of same typology erected over same duration/period, multiple linear regression may be used to estimate weighting coefficients given to each value criterion in order to statistically determine if a given heritage value has a higher weighting than the rest. For such sample sizes, threshold values in the scoring system distribution may be extrapolated using standard deviations – assuming the scores are distributed normally – or a set of established percentiles which indicate specific criteria and thus categorize the heritage grading of a given site in terms of the final score attained.

Laypersons and heritage professionals differ from policy makers in evaluation historic buildings because they base their judgements on different criteria [49]. Computing heritage value as suggested provides the formulation of a less subjective grading of built heritage which can be applied across diverse cultural contexts. It is useful in decision-making regarding the scheduling of built heritage. A main limitation is the fact that assigning a score to each heritage value is still subjective, especially if undertaken by an assessor or a several coming from a specific lobby. This can be minimized by finding the mean value attributed by multiple assessors from different sectors of society for the same heritage site.

#### Declaration of competing interest

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