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Evaluation of 'Architectural and Aesthetic Value' of Built Heritage: A Comparison of Weightage Methods

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Abstract

Conserving all architectural heritages may not be feasible in future cities. Hence, for future cities, what to retain from the past is a big question to solve. Proclaiming architectural heritage needs some background study of the parameters which significantly influences the heritage in many ways. Therefore, this study acknowledges the relative values of parameters to validate the role of the architectural heritage for conservation. This study also focuses on the level of importance of the parameters while evaluating the architectural heritage. In the process of evaluation of architectural heritage, the identified literature is obtained from three sources - international organizations, government agencies, and architectural heritage scholars. More or less, all the studies have given their parameters for evaluating architectural heritage by the traditional, chronological, and geographical concepts which are relevant for a region. Commencing the literature review, 'Architectural and Aesthetic Value' is found to be a prime dimension while evaluating the architectural heritage. A methodology has been adopted to get its sub-dimensions and parameters which can help in assessing the architectural heritage in terms of its 'Architectural and Aesthetic Value.' To get the quality of parameters and their relative importance, a Delphi Technique has been adopted through conducting surveys of the experts of the architecture and other allied fields. Further, various statistical weightage techniques are compared for the better assessment of the built heritage. The results of the research show the relative importance of the parameters while selecting the architectural heritage, specifically its 'Architectural and Aesthetic Value.' The results would also help in evaluating other dimensions of architectural heritage and expand the scope for future research in prioritizing the architectural heritage for the benefit of society.

Keywords: Architectural Heritage; Architectural and Aesthetic Value; Ranking of Parameters; Weightage of Parameters; Delphi Technique

1 Introduction

Heritage means the inheritance of things from the ancestors, protection of them in the present and giving it back to the future generation. According to ICOMOS (Ahmad, 2006), architectural heritage "*these include archaeological sites and ruins, tombs, traditional architecture, cave temples and historic villages and towns."* Further Senthil (2016), *"The main goal of architectural*

heritage conservation is to protect the significance of a place through the expression of the existing physical embodiments." Hence for evaluation of architectural heritage, not only the present condition but also the past and future conditions need to be considered. Identifying the significance of architectural heritage in modern-day, Timothy (1995) mentioned, *"Heritage is not simply the past but the modern-day use of elements of the past."* Conservation of every piece of architectural heritage (AH) is not economically feasible for a nation, considering the limitations of resources and functional efficiency; it is essential to have a robust evaluation system for selecting and prioritizing architectural heritage to be conserved.

2 Literature Review

In the first part of this paper, we have listed out the criteria from different international, national agencies, and individual scholars who are directly or indirectly involved with the process of evaluation of architectural heritage. In the second part, we have identified different weighting methods derived from the ranking process, their pros and cons, and uses.

2.1 Identification of Parameters for the Architectural and Aesthetic Value'

After identifying the different value assessment systems for architectural heritage, this paper broadly categorizes the sources of assessment criteria into three groups (i) International organizations (IO), (ii) government agencies (GA) and (iii) architectural heritage scholars (AHS).

Table 1: List of Assessment Criteria for 'Architectural and Aesthetic Value'

Assessment Criteria	**IO**	**GA**	**AHS**
Architectural Intactness	ICOMOS (2004)	Neale (2011); Vaughan Heritage Inventory (2015)	Saradj (2011, p. 19)
Architectural Integrity	ICOMOS (2002)	Neale (2011)	Saradj 2011, p. 19)
Beauty of AH	ICOMOS (2004); Australian ICOMOS (2000)	Vaughan Heritage Inventory (2015)	Avrami, Mason, and Torre (2000, p. 29);
Characteristic of AH	Not Applicable	Heritage Advisory Committee Ontario Heritage Act (2013)	Landriani and Pozzoli (2014, pp. 101-109)
Enclosure	ICOMOS (2002)	Not Applicable	Not Applicable
Form and Design	Australian ICOMOS (2000)	Neale (2011); Heritage Advisory Committee Ontario Heritage Act (2013);	Avrami, Mason, and Torre (2000, p. 29)
Landmark Status	Not Applicable	Heritage Advisory Committee Ontario Heritage Act (2013)	Landriani and Pozzoli (2014, pp. 101-109)
Landscape Value	Not Applicable	Heritage Advisory Committee Ontario Heritage Act (2013)	Landriani and Pozzoli (2014, pp. 101-109)
Material Condition	Australian ICOMOS (2000)	Vaughan Heritage Inventory (2015)	Saradj (2011, p. 19)
Rarity in Architectural Details	ICOMOS (2002)	Heritage Advisory Committee Ontario Heritage Act (2013)	Saradj (2011, p. 19)
Rarity in Age	Not Applicable	Heritage Advisory Committee Ontario Heritage Act (2013)	Saradj (2011, p. 19)
Rarity in Material and Construction Techniques	Not Applicable	Heritage Advisory Committee Ontario Heritage Act (2013)	Saradj (2011, p. 19)
Scale	Australian ICOMOS (2000)	Not Applicable	Not Applicable
Scientific and Technological Value	ICOMOS (2004); Australian ICOMOS (2000)	Heritage Advisory Committee Ontario Heritage Act (2013)	Avrami, Mason, and Torre (2000, p. 29)

By using the methodology (Fig. 1), all the parameters are identified. The result of the process, along with their description and scale of measurement, are shown in Table 2.

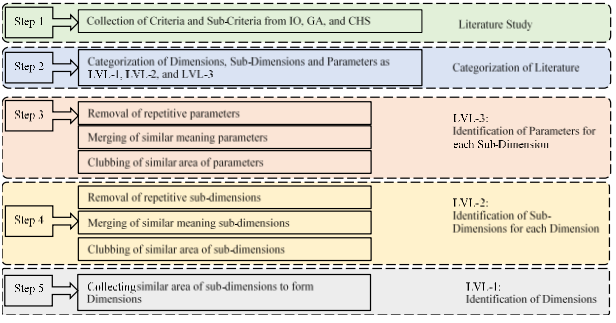

Fig. 1. Methodology for Identifying Dimensions and Parameters

Table 2: Sub-Dimensions and Parameters of 'Architectural and Aesthetic Value'

Parameters	Description	Scale of Measurement
Aesthetic Value (A1)		
Beauty (A11)	Architectural heritage is identified by the perception of beauty by the human mind.	Extremely beautiful/ Moderately beautiful/ Somehow beautiful/ Moderately less beautiful/ Not beautiful
Form and Design (A12)	Architectural heritage is valued because of its merit in the form, design, composition, or details in the planform of the structure.	Navaratha/ Saptaratha/ Pancharatha/ Triratha/ No identified form of Odishan temple
Scale (A13)	Architectural heritage has a scale (size) of the structure, derived from human visualization and sensitivity.	Giant in size/ Very large/ large/ fair/ Small size
Enclosure (A14)	A notable example of the particular architectural style with a sense of enclosure with proper boundary condition.	excellent/ very good/ Good/ Fair or Average/ No sense of enclosure)
Architectural and Alteration Value (A2)		
Architectural Intactness (A21)	It is the present condition of the architectural heritage representing wholeness in design and form in comparison to the architectural heritage when it was executed.	No Change / Negligible Change/ Slight Change/ Most Change/ Total Change to its completeness with the original structure when executed
Architectural Integrity(A22)	Architectural integrity is the quality of being honest, and having moral principles of architectural heritage continues and proceeds along with design, historical data unchanged with the current state.	Extremely honest/ Highly honest/ Moderately honest/ Less honest/ Not honest
Material Condition (A23)	The present material condition shows the originality of material used during the execution of the architectural heritage.	Unchanged/ Changed with slight alterations/ Changed with moderate alterations/ Maximum parts are changed/ Totally changed)
Rarity Value (A3)		
Rarity in Age (A31)	The uniqueness of the architectural heritage regarding age, dynasty, and a particular period.	Architectural heritage is identified by its age easily/ with little difficult/ with difficulty/ with high difficulty/ not identified by its age.
Rarity in Architectural Details (A32)	Architectural heritage is identified for its unique architectural details, i.e., its planform and facade design.	Architectural heritage is identified by its architectural details with easily/ with little difficult/ with difficulty/ with high difficulty/ not identified
Rarity in Material and Construction Techniques (A33)	The uniqueness of architectural heritage is based on the construction method of execution.	Architectural heritage shows materials and construction techniques which are easy/ moderately easy/ difficulty/ moderately difficult/ not to identify the Odishan temple architecture.
Scientific and Technological Value (A34)	Architectural heritage is identified by its scientific and technological value.	Architectural heritage is identified by its scientific and technological value easily/ with little difficult/ with difficulty/ with high difficulty/ not identified
Contextual Value (A4)		
Characteristic (A41)	Architectural heritage contributes to the continuity or character of the street, neighborhood, or area.	Strongly Agree/ Moderately Agree/ Agree/ Moderately Disagree/ Strongly Disagree)
Landmark Status (A42)	Architectural heritage is a landmark.	Strongly Agree/ Moderately Agree/ Agree/ Moderately Disagree/ Strongly Disagree
Landscape Value (A43)	Inter-relationship between architectural heritage and its surrounding landscape.	Strongly Agree/ Moderately Agree/ Agree/ Moderately Disagree/ Strongly Disagree

2.2 Multi-criteria Decision Making Process and Ranking Methods

Deriving ranks for each parameter from the first round of Delphi, each dimension has been assigned weight vector $W = [W_{11}, W_{12}, \dots, W_{43}]$, satisfying $W_{11} + W_{12+} \dots + W_{43} = 1$.

$$C_{ij} = \frac{X_{ij} - Min\ X_{ij}}{Max\ X_{ij} - Min\ X_{ij}} \qquad \text{Equation 1}$$

Where X_{ij} is the score given by the expert of the i-th alternative concerning j-th parameter before normalization. The simple and effective way of multi-attribute decision techniques is the *Simple Additive Weighting (SAW)* (Tzeng & Huang, 2001).

$$S_i = \sum_{j=1}^{n} C_{ij} W_j \qquad \text{Equation 2}$$

Where S_i is the score for i-th alternative and C_{ij} is the normalized score of the i-th alternative concerning *j*-th criteria and W_j is the weight criteria j are as before.

Table 3: Literature of Different Rank Weight Methods

Types of Methods	Formula	Conditions	Sources
Equal Weight Method (EW)	$W_i(EW) = {}^1/_n$	Minimal or no knowledge about the level of priority among the parameters, Having a high correlation among all the co-parameters	Stillwell et al., (1981)
Rank Sum Weight Method (RS)	$W_i(RS) = \frac{2(n+1-r_i)}{n(n+1)}$	When researchers know the rank of the parameter Having high to mid-level correlation among parameters	Stillwell et al., (1981)
Rank Exponent Weight Method (RE)	$W_i(RR) = \frac{{}^1/_{r_i}}{\sum_{k=1}^{n} {}^1/_{r_k}}$	It requires an additional piece of information, i.e., the numbers of iteration use for the process. The respondent judges the weight of the most important attribute	Barron and Barrett (1996)
Inverse or Reciprocal Weight Method (RR)	$W_i(RE) = \frac{(n-r_i+1)^p}{\sum_{k=1}^{n}(n-r_k+1)^p}$	This inverse or reciprocal weights are calculated from the normalized reciprocals of the parameter's rank	Stillwell et al., (1981)

Rank Order Centroid Weight Method (ROC)	$W_i(ROC) = \frac{1}{n}\sum_{k=i}^{n}\frac{1}{r_k}$	ROC weight calculates the weights by minimizing the maximum error by estimating the weights of all possible parameters by maintaining the rank order of the importance of the parameters. Two conditions are required for the ROC method, i.e., $W_{r1} \geq W_{r2} \geq \cdots \geq W_{rn}$ and $W_{r1} + W_{r2} + \cdots + W_{rn} = 1$	Barron and Barrett (1996)

Where: 'i' = 1, 2, …, n and n is the number of parameters used in the research.
'r_i' is the rank of the i-th criterion and n is the number of parameters.
'r_k' is the rank of the k-th criterion (while summing of each criterion)
'p' is the numbers of an iterative process, If p = o then it defines the equal weights among the parameters if p = 1, then it defines rank-sum weights

3 Methodology

We have conducted in expert opinion survey, for the level of importance of the parameters, for reviewing the parameter statement/ items and their comments and suggestions for individual parameters under each sub-dimensions of 'Architectural and Aesthetic Value.' We have depended upon the Delphi method to examine the consensus among the group of experts for the reliability and validity of the parameters. We conducted a Delphi survey with the help of 12 experts giving the same weightage to each expert from the allied fields. For the first round of the survey, the experts were asked to rank all the parameters, where description and scale of measurement were given for their references. In the first round, this Delphi survey included 43 questions/ parameters based on 'Architectural Heritage.'

4 Analysis

For the analysis purpose, collected data and their further calculation are shown in Table 4 and different ranking methods have been compared in

Table 4: Analysis of Selecting Parameters for evaluation of Architectural and Aesthetic Value

Variables/ Questions	Median	Mean	Rank obtained from Mean	Interquartile Range	Frequency of Variables in %					Aggregated Value		Remarks
					EI	MI	I	MNI	ENI	% of EI + % of MI	% of EI + % of MI + % of I	
A11	4	3.64	13	1.5	27.27%	27.27%	27.27%	18.18%	0.00%	72.73%	81.82%	S
A12	5	4.64	2	1	63.64%	36.36%	0.00%	0.00%	0.00%	36.36%	100.00%	S
A13	5	4.45	4.5	1	63.64%	18.18%	18.18%	0.00%	0.00%	36.36%	100.00%	NS
A14	4	3.45	14	1	0.00%	72.73%	0.00%	27.27%	0.00%	100.00%	72.73%	NS
A21	5	4.27	7	1	63.64%	18.18%	0.00%	18.18%	0.00%	36.36%	81.82%	S
A22	5	4.73	1	0.5	72.73%	27.27%	0.00%	0.00%	0.00%	27.27%	100.00%	S
A23	3	3.82	11.5	2	36.36%	9.09%	54.55%	0.00%	0.00%	63.64%	100.00%	S
A31	5	4.45	4.5	1	63.64%	18.18%	18.18%	0.00%	0.00%	36.36%	100.00%	S
A32	5	4.55	3	1	63.64%	27.27%	9.09%	0.00%	0.00%	36.36%	100.00%	S
A33	4	4.09	8.5	2	45.45%	18.18%	36.36%	0.00%	0.00%	54.55%	100.00%	S
A34	4	3.82	11.5	2.5	45.45%	18.18%	9.09%	27.27%	0.00%	54.55%	72.73%	S
A41	5	4.36	6	1.5	63.64%	9.09%	27.27%	0.00%	0.00%	36.36%	100.00%	S
A42	4	4.09	8.5	0	18.18%	72.73%	9.09%	0.00%	0.00%	81.82%	100.00%	S
A43	4	3.91	10	1.5	36.36%	36.36%	9.09%	18.18%	0.00%	63.64%	81.82%	S

Parameters were chosen as based on:

- Median Value more than 3 (i.e., More than Important) (Raskin, 1994)
- Mean Value more than 3 (i.e., More than Important) (Raskin, 1994)
- More than 70% of the opinion of experts have 'Extremely Important' and 'Moderately Important.' (Meshkat et al., 2014)
- Interquartile Range should be less than 1.5 (i.e., the variation in the opinion of experts from the median values) (Meshkat et al., 2014)
- Note: As selecting of a parameter is a triangulation method, from the above four conditions if two are satisfied, then parameter is selected for next-level research.

Where, ENI: Extremely Not Important, MNI: Moderately Not Important, I: Important, MI: Moderately Important, EI: Extremely Important, S: Selected, NS: Not Selected)

Table 5: Comparing of Parameters Weights by different Rank Weight Techniques

Indicator	Ranks	Weights by EW	Weights by RS	Weights by RE	Weights by RR	Weights by ROC
Beauty	13.0	0.07	0.02	0.00	0.02	0.01
Form and Design	2.0	0.07	0.12	0.17	0.15	0.16
Scale	4.5	0.07	0.10	0.11	0.07	0.10
Enclosure	14.0	0.07	0.01	0.00	0.02	0.01
Architectural Intactness	7.0	0.07	0.08	0.06	0.04	0.06
Architectural Integrity	1.0	0.07	0.13	0.19	0.31	0.23
Material Condition	11.5	0.07	0.03	0.01	0.03	0.02
Rarity in Age	4.5	0.07	0.10	0.11	0.07	0.08
Rarity in Architectural Details	3.0	0.07	0.11	0.14	0.10	0.12
Rarity in Material and Construction Techniques	8.5	0.07	0.06	0.04	0.04	0.05
Scientific and Technological Value	11.5	0.07	0.03	0.01	0.03	0.02
Characteristic	6.0	0.07	0.09	0.08	0.05	0.07
Landmark Status	8.5	0.07	0.06	0.04	0.04	0.04
Landscape Value	10.0	0.07	0.05	0.02	0.03	0.03
	Total Sum	1.00	1.00	1.00	1.00	1.00

5 Result

The results indicate that the gap between the highest weighted parameter and lowest weighted parameter values are not in EW method. However, it substantially increases in the case of RR and ROC methods. It can be concluded her, if the researcher knows the importance among the parameters the RR and ROC methods are more useful than EW and RS methods. Again, if there is a high correlation among the parameters and level of importance is not known than EW, and RS methods are applicable. RE methods are useful when there is a mixed sense of both conditions.

Table 6:Comparing of Sub-Dimensions Weights by different Rank Weight Techniques

Sub-Dimensions	Weights by EW	Weights by RS	Weights by RE	Weights by RR	Weights by ROC
Aesthetic Value (A1)	0.2857	0.2524	0.2805	0.2683	0.2769
Architectural and Alteration Value (A2)	0.2143	0.2429	0.2686	0.3790	0.3120
Rarity Value (A3)	0.2857	0.3095	0.3046	0.2343	0.2734
Contextual Value (A4)	0.2143	0.1952	0.1463	0.1184	0.1378
Total Sum	1.0000	1.0000	1.0000	1.0000	1.0000
Comparision	A1=A3>A2=A4	A3>A1>A2>A4	A3>A1>A2>A4	A2>A1>A3>A4	A2>A1>A3>A4

6 Conclusion

The main objective of this paper is to find a methodology for evaluating the 'Architectural and Aesthetic Value' of any architectural heritage. In this regard, a Simple Additive Weighting (SAW) and different weightage methods from the ranking techniques are used to evaluate the 'Architectural and Aesthetic Value.' Various techniques like EW, RS, RE, RR, and ROC are used to get a relative weightage. In most of the cases, one critical observation is that all the parameters' weights are depended on the total number of parameters. Again, in any case, irrespective of any problem, if the fixed amount of parameter/ attributes is their then all the ranking weightage system, it will give the fixed weightage value to all the parameters according to their ranks. In the real world scenario, the parameters are interlinked with others; their level of correlation may cause the disturbance of the weightage system. Therefore, this paper gives a further scope of research to find out the inter-relationship between the parameters from the collected data and using other multi-criteria techniques to get the weightage to find out the total score of 'Architectural and Aesthetics Value' of any architectural heritage.

References

Ahmad, Y. (2006). The scope and definitions of heritage: From tangible to intangible. *International Journal of Heritage Studies*, *12*(3), 292–300. https://doi.org/10.1080/13527250600604639

Australian ICOMOS. (2000). *The Burra Charter*. Burwood: Australia ICOMOS Incorporated.

Avrami, E., Mason, R., & Torre, M. de la. (2000). Values and Heritage Conservation. In *The Getty Conservation Institute*. Los Angeles.

Barron, F. H., & Barrett, B. E. (1996). Decision Quality Using Ranked Attribute Weights. *Management Science*, *42*(11), 1515–1523. https://doi.org/10.1287/mnsc.42.11.1515

Heritage Advisory Committee Ontario Heritage Act. (2013). *7005 Pond Street- Heritage Assessment*. Ontario.

ICOMOS. (2002). International Cultural Tourism Charter. In *ICOMOS International Cultural Tourism Committee*.

ICOMOS. (2004). *International Charters for Conservation and Restoration* (2nd ed.). Paris: ICOMOS.

Landriani, L., & Pozzoli, M. (2014). *Management and Valuation of Heritage Assets: A Comparative Analysis Between Italy and USA*. https://doi.org/10.1007/978-3-319-01763-1

Meshkat, B., Cowman, S., Gethin, G., Ryan, K., Wiley, M., Brick, A., … Mulligan, E. (2014). Using an e-Delphi technique in achieving consensus across disciplines for developing best practice in day surgery in Ireland. *Journal of Hospital Administration*, *3*(4), 1–8. https://doi.org/10.5430/jha.v3n4p1

Neale, S. (2011). *Evaluating Heritage Resources in the City of Thorold*. Thorold.

Raskin, M. S. (1994). The delphi study in field instruction revisited: Expert consensus on issues and research priorities. *Journal of Social Work Education*, *30*(1), 75–89. https://doi.org/10.1080/10437797.1994.10672215

Saradj, F. M. (2011). Prioritization of historic buildings based on their values. *International Journal of Architectural Engineering & Urban Planning*, *21*(1), 17–26.

Senthil, R. B. (2016). Sustainable Heritage Management-Need and Challenges Sustainable Heritage Management- Need and Challenges. *Indian Journal of Research*, *5*(12), 478–483.

Stillwell, W. G., Seaver, D. A., & Edwards, W. (1981). A comparison of weight approximation techniques in multiattribute utility decision making. *Organizational Behavior and Human Performance*, *28*(1), 62–77. https://doi.org/10.1016/0030-5073(81)90015-5

Timothy, D. J. (1995). Value System in Archaeology. In *Managing Archaeology* (pp. 38–48).

Tzeng, G.-H., & Huang, J.-J. (2001). Multiple Attribute Decision Making: Methods and Applications. In *CRC Press*.

Vaughan Heritage Inventory. (2015). *Heritage Impact Assessment*. Ontario, Canada.