

Development of a Methodology for Assessing the Technical Level of Cultural Heritage Objects in Construction

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Abstract

Cultural objects (building and construction) that are considered as the most valuable segment of real estate in terms of historical heritage usually evaluated only by monetary aspects. Not concreteness of the approaches to the determination of the historical heritage objects leads to the fact that its original value often remains unread, the assessment has subjective character, reflects the values of certain time frame and place. Therefore, for the purpose of determination of value of the historical heritage objects, there is need for the creation of the unified classification system of their assessment. Thus, this research is considered to be very relevant. The paper investigates intangible factors that affect the evaluation of cultural heritage objects in construction. In the work a system of value indicators, which take into account not only tangible indicators but also the intangible value of cultural heritage objects, has been developed. Developed indicators system makes it possible to evaluate the historical and cultural value of real estate objects quite objectively on the contrary to common methods which deal only with monetary aspects of market price of such objects. A methodology for a comprehensive evaluation of cultural heritage objects has been formed as well. This methodology is based on both the traditional comparative approach and the system of value indicators. As a result, suggested integrated approach has been proven to provide fair evaluation of both the tangible and intangible characteristics and improve the quality of cultural heritage objects assessment process.

Keywords: Cultural Heritage Objects; Planning System; Intangible Value; Market Evaluation.

1. Introduction

Cultural heritage objects (building and construction) are the most valuable segment of real estate in terms of history, archeology, architecture, urban planning, art, science and technology, aesthetics, ethnology or anthropology, social culture and are evidence of eras and civilizations, sources of information about culture [1].

Despite the value of cultural heritage objects, most of these constructions and buildings require restoration. Therefore, there is a practice of transferring cultural heritage objects into the ownership of investors, or in transferring objects for a long-term lease (usually for 49 years). Sale or long-term lease of cultural heritage sites are one of the ways to preserve the intangible value of such buildings [2].

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As a result, cultural heritage objects are involved into market turnover. For the purposes of selling, insuring, privatizing, pledging in a bank, an assessment of these objects is required. A contradiction arises between the need to conduct market transactions with cultural heritage objects and the lack of an objective methodology for evaluation of the intangible component that present historical and cultural value of these objects to the real estate market.

A comprehensive methodology for assessing design solutions for cultural heritage objects is necessary not only for performing operations with these objects (sale, privatization, insurance, long-term lease), but also for presenting their historical, cultural, architectural and aesthetic value [3].

Traditional approaches to real estate market value assessment usually take into account only the technical characteristics of buildings, ignoring their historical and cultural value. The Methodological Recommendations for the Assessment of Real Estate Objects (dated 23.06.2015) states that the intangible value should be taken into account via special adjustment factors. However, sufficient and thorough researches on the development of a system of value indicators can be hardly found.

The lack of objective approaches to the cultural heritage objects evaluation leads to inadequate, high subjective and untrustworthy results. Thus, the problem of cultural heritage objects evaluation is relevant and requires the development of a value indicators system. The purpose of the study is to improve the quality of the cultural heritage objects assessment process based on the development of a value indicator system. Research objects is assessment process of the technical state of design solution of cultural heritage objects.

The subject of the research is the value indicators system for cultural heritage objects. The scientific novelty of the research lies in the development of a value indicators system that will take into account the intangible value of cultural heritage objects. This system allows obtaining an objective market value of the historical and cultural objects. The practical value comes from development of a comprehensive methodology for evaluation of real estate cultural heritage sites.

To achieve this goal, the following tasks have been solved:

- Research of intangible value of cultural heritage objects;
- Analysis of methods for assessing cultural heritage sites;
- Development of a value indicators system;
- Development of a methodology for evaluation of design solution technical state of cultural heritage objects.

According to the tasks solved the structure of the article includes the following sections:

- Cultural heritage objects classification;
- Comparative analysis of methodologies for cultural heritage objects evaluation;
- Methods of cultural heritage objects evaluation;
- Characteristics of the indicators system for cultural heritage objects;
- The results of the expert assessment,
- Discussion;
- Conclusion.

2. Literature Review. Analysis of the Problems of Evaluation of Design Solution Technical State of Cultural Heritage Objects

2.1. Cultural Heritage Objects Classification

According to the normative and technical documents, the assessment of the design solution technical state of capital construction projects is a set of operations (measures) aimed at comparing the technical and economic indicators and quality characteristics of analyzed object with baseline of these indicators. Evaluation of the design solutions technical state of cultural heritage objects has its own specifics, the quality indicators of these objects have historical, cultural, architectural and aesthetic value, which is absent in the typical real estate objects [3].

It should be noted that cultural heritage objects (monuments) can be profitable on its own or financed from the city/region/state budget [4]. This work considers only profitable objects. Result analysis of scientific information search allowed building a multilevel classification of cultural heritage objects (Table 1).

Table 1. Classification of cultural heritage objects

Criterion	Object examples
Types	monuments, ensembles, sights
Category	objects of federal level, objects of regional level, objects of municipal level
Profitability	profitable on their own, financed from state budget
Type of design solution	enfilade, cabinet, enfilade-cabinet, compact (centric)

Types of design solutions have its own features, advantages and disadvantages:

- Enfilade type is a building planning system that provides for the transition from one room to another through openings in walls or partitions. The system does not include corridors and other areas that reduce the usable area of the building;
- Cabinet type is a system, most commonly used in office buildings, involves the location of rooms on both sides of the corridor;
- Enfilade-cabinet type is a combination of the first two systems;
- Compact (centric) type is characterized by a large room in the center (core) with surrounding rooms of a smaller area.

Result analysis of scientific information search allowed building a multilevel classification of cultural heritage objects (Table 2).

Table 2. Advantages and disadvantages of design solution types

Design solution type	Advantages	Disadvantages
Enfilade	<ul style="list-style-type: none"> - Buildings have sufficient bearing capacity - Ability to re-plan during reconstruction - Ability to designing compact buildings 	<ul style="list-style-type: none"> - A large number of walk-through rooms that reduces usable area - The planning system is suitable only for objects with museum/exhibition purposes, but not for profitable real estate - Lack of utility rooms
Cabinet	<ul style="list-style-type: none"> - System provides private spaces and rooms - Minimization of noise level 	<ul style="list-style-type: none"> - Inefficient usage of office space - Additional expenses for lighting, air conditioning
Enfilade-cabinet	<ul style="list-style-type: none"> - Efficient usage of spaces - Usage of advantages of both solution types 	<ul style="list-style-type: none"> - Long dark corridors through the building
Compact (centric)	<ul style="list-style-type: none"> - Suitable for cultural spaces like cinemas, concert halls, theatres 	<ul style="list-style-type: none"> - Inefficient in terms of profitability (such buildings are hard to lease)

It is clear from the table that the most suitable design solution type for profitable real estate objects is enfilade-cabinet one.

2.2. Comparative Analysis of Methodologies for Cultural Heritage Objects Evaluation

The following diagram (Figure 1) can represent the main approaches in the field of preservation and protection of cultural heritage objects.



Figure 1. Main approaches for preserving cultural heritage objects worldwide

Analysis of the policies in the field of protection and preservation of cultural heritage objects in foreign countries [5-7], the following conclusions have been drawn:

- The preservation and maintenance of the cultural heritage objects is impossible only with the funds of the state budget [8-10];
- In most countries, assessment and evaluation of cultural heritage objects are carried out by special committees [15-18];
- Attraction of investments for the protection, restoration and preservation of cultural heritage objects can be done in various ways (privatization, sale, trust management, long-term lease, and tax incentives) [12-14].

2.3. Methods of Cultural Heritage Objects Evaluation

In European countries, there are several methods for evaluation of cultural heritage objects. The most spread ways to use privatized cultural heritage objects are associated with tourism: museum sites, recreational sites (hotel use, residential real estate open for visits and excursions) [11, 12]. The most popular evaluation methods come from the UK and undergo continuous improvement even today. The diagram (Figure 2) shows the main methods for evaluation of cultural heritage objects in European countries [17].

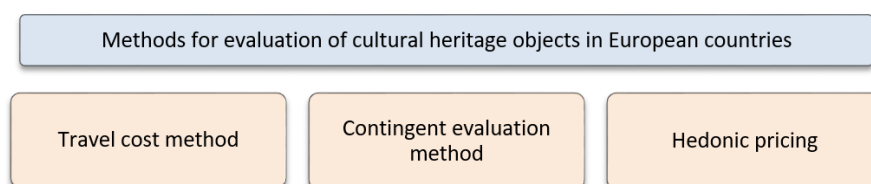


Figure 2. Methods for evaluation of cultural heritage objects in European countries

The travel cost method is to convert the time and money spent on visiting a cultural heritage object into characteristics of cultural heritage object (technical state) [14, 15]. The technical state of a cultural heritage property is calculated as the sum of the cost per visitor of this property for tickets, fuel and time multiplied by the average annual number of visitors. The scheme for assessing the technical level of design solutions is shown in Figure 3 [17, 18].

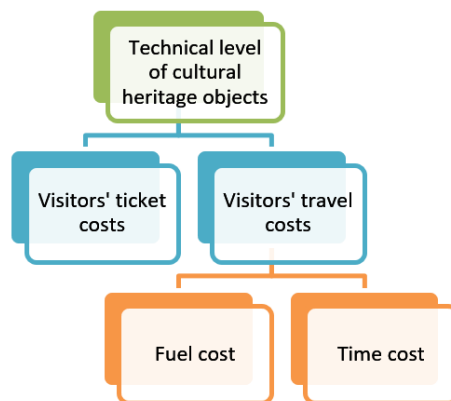


Figure 3. Travel cost method scheme

Monetary values for time and fuel can be derived from Department of Transportation data (Forrest et al 2000). The calculations use averaged data. The technical level of design solutions, calculated by the travel costs method, can be represented by the following formula [19]:

$$TL = (C_e + C_t + C_f) \times n \quad (1)$$

Where TL – Technical level of cultural heritage objects, C_e is entry ticket cost, C_t is monetary value of time spent on travelling and site visit, C_f is fuel cost spent on travelling to the site, n is the number of annual visitors.

The main disadvantages of the travel cost method are:

- The travel time and cost cannot accurately reflect the technical level of the property itself;
- In order to adequately determine the cost of time and fuel, it is necessary to conduct consumer surveys, which leads to errors in calculations;

- This method is applicable only for a narrow segment of cultural heritage objects (such as museums, cultural spaces etc.).

This method was widely used to evaluate Scottish museums, objects in Armenia, as well as the Alto Douro wine region in Portugal. The contingent evaluation method is a universal and commonly used in European countries. It is based on finding the average technical level of the object that include consumer and unused value [15, 18].

The consumer value is formed for profitable real estate objects and is determined by the market price of similar objects. This cost does not take into account the cultural value of the object and reflects only the economic component [17]. The unused value shows the intangible value of an object and as well, as how much a country's residents are willing to pay to preserve this object and pass on its heritage to the next generations. The expert group draws up questionnaires and, based on the results of a survey of country residents, release a coefficient of the unused value. This method cannot be called accurate, since the survey answers may be biased.

The hedonic pricing method is based on intangible factors that increase the value of a cultural heritage property. Researches reveal the dependence of sale price of the objects located near cultural heritage objects in relation to the sale price of similar real estate objects located in an ordinary city district. A calculated coefficient reflects the value of the cultural heritage object [16, 17]. Also in the UK, there is an expert method, in which independent specialists (experts) derive coefficients reflecting the intangible value of an object. The coefficients were calculated according to the following criteria: the level of aesthetics, spiritual value, social value, authorship, the symbol of the settlement, the historical symbol, the historical value [21, 22]. There are several standard approaches to real estate evaluation in Russian Federation [13, 23-26] (Figure 4).

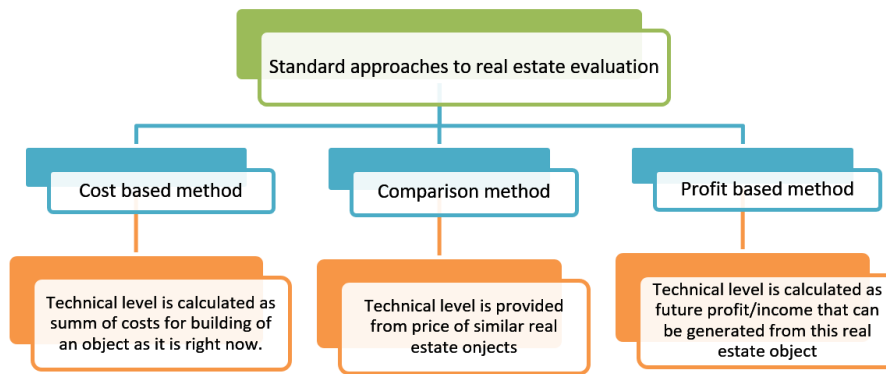


Figure 4. Descriptive scheme for standard approaches to real estate evaluation in Russian Federation

Main disadvantages of evaluation methods mentioned above are presented in Figure 5.

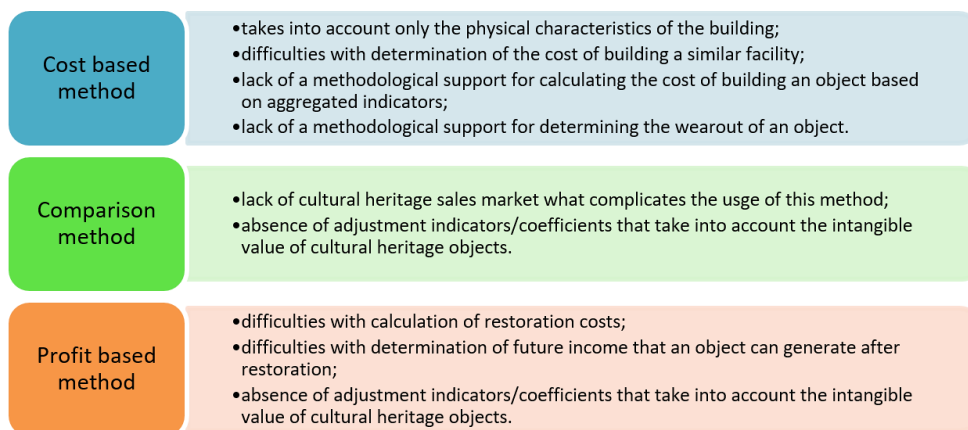


Figure 5. Descriptive scheme for standard approaches to real estate evaluation in Russian Federation

The traditional methods, provided in Figure 4 are not applicable in their classical treatment to assessment of technological level of objects of cultural heritage. Therefore, the author's techniques, which are briefly analyzed in the article, are in practice known. T.A. Slavina's technique is the earliest of all the techniques existing for now. It is based on the cost approach, considers some technical and quality characteristics of the building, without the land plot under the objects. The technological level of objects of cultural heritage (according to Slavina's technique is presented in the general form in Figure 6.

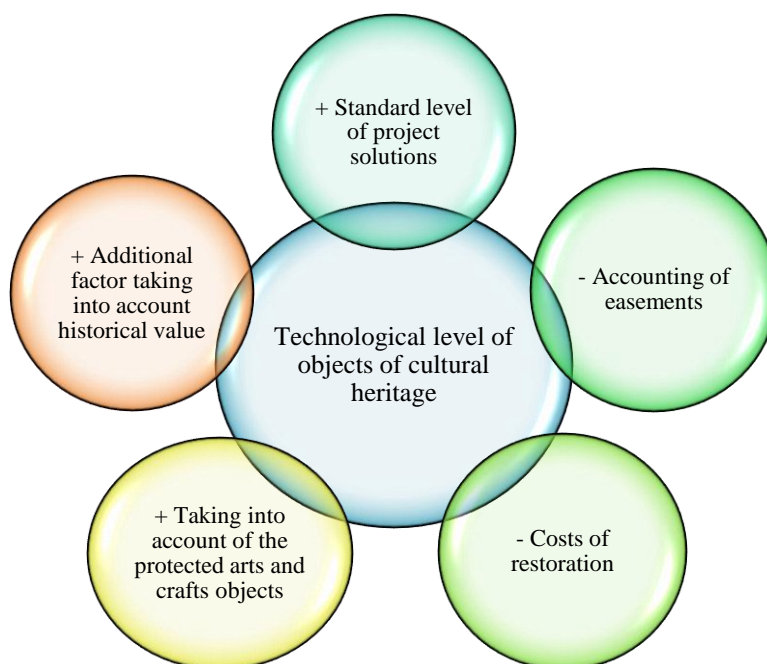


Figure 6. Assessment of technological level of the objects of cultural heritage with the use of T.A. Slavina's technique

A.V. Lukov's technique is also based on the cost approach. The calculation is conducted without the cost of the land plot under the object of cultural heritage. The technique can be in general expressed by the Equation 2:

$$T = R_s \times (1 + C_o) \times C_u \times (1 - W) - ZDP \quad (2)$$

Where: T: Technological level of the object of cultural heritage; R_s : Recovery size (cost of new construction, cost of restoration and residual cost); C_o : Dimensionless coefficient, building value indicator; C_u : Uniqueness coefficient; W: Saved-up wear; ACM: The additional costs for the object maintenance.

E.E. Yaskevich's technique is based on two methods, which are the cost and revenue methods:

$$T = R_s \times PP \times (1 - We) + P - If - Ss + C_{3y} \pm HBC \quad (3)$$

Where: T: Technological level of the object of cultural heritage; R_s : Recovery size; PP: Entrepreneur profit; We: External wear; P: Prestigiousness; P: Physical deterioration; If: Easement size; Ss: The size of the land plot; C_{3y} : Specific features; HBC: Unrecorded value types.

However, it is difficult to determine the size of prestigiousness of the object with the use of this technique. O.E. Tolstova's technique assumes the assessment of object of cultural heritage as the standard building which is not of cultural value. This technique is based on the comparative and revenue methods. The income analysis which brings the object of cultural heritage and the standard building is made. On the basis of the obtained information "the historical reputation" of the object is defined. However, some difficulties of practical application of this technique are caused by closeness of information on the market of objects of cultural heritage.

The author's technique created by Bashkatov V.S. which is based on the cost approach is the most clear one. According to this technique the technological level of the object of cultural heritage consists of three composed, including the land plot, improvements and non-material component. The non-material component is defined by assessment of labor input of works on restoration of architectural decorative elements. Having carried out the analysis of the aforesaid author's techniques, we should note that the well-known author's techniques have the problem of the translation of quality culturological characteristics of the object of cultural heritage into quantities. Besides, the cost approach does not allow to define the non-material component of the object.

In practice, appraisers adapt standard approaches when evaluating a specific property. Thus, there is a clear need in a unified methodology for real estate evaluation, which would take into account the intangible value of cultural heritage objects. Moreover, international experience in evaluation of cultural heritage objects does not have the practice of re-profiling cultural heritage sites for other purposes.

3. Research Methods: Development of a Value Indicators System for Cultural Heritage Objects

According to the analysis of the evaluation methods of the objects of cultural heritage (item 2) and techniques of the assessment of objects of antiques and art products, we can draw the conclusion about the impossibility of application of the cost approach to the assessment of objects of cultural heritage. According to the authors, it is possible to apply the method of the analysis of hierarchies which is used for the assessment of art products and products from antiques to the assessment of objects of cultural heritage. The essence of the method of the analysis of hierarchies is provided in figure 7 (the global purpose is the object assessment; the intermediate levels (criteria) are the characteristics of the object; alternatives are the similar objects).

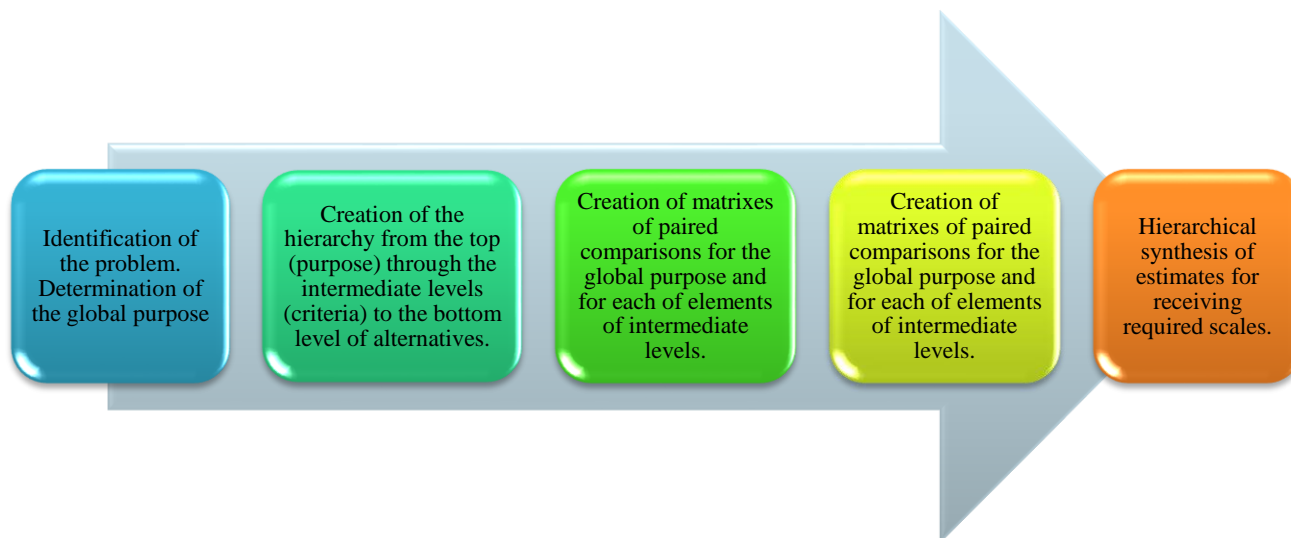


Figure 7. Stages of the method of the analysis of hierarchies

To develop a system of value indicators, cultural heritage objects are divided by profitability into several groups as following:

- Buildings fully equipped for commercial purposes (offices, banks, residential and hotel real estate),
- Buildings partially equipped for commercial purposes,
- Buildings not meant for commercial use (culture, art, education),
- Religious buildings,
- Public buildings (consulates, budgetary organizations, government buildings),
- Buildings in disrepair, the use of which is impossible without proper restoration.

Objects of cultural heritage have intangible value, which is determined by a set of certain factors (Table 3) [27, 29].

Table 3. Indicators for intangible value of a cultural heritage object

Value type	Advantages
Historical	Date of construction; Monument status; Relation to a certain architectural style and epoch; Connection to certain historical events or personalities; Ownership history.
Urban	The role of the object in the urban system or the natural environment; Increase of the attractiveness of the location due to the presence of an object; Stimulation of building constructions of architectural style of an object.
Aesthetic	Relation to the heritage of a certain author; Relation to a certain architectural ensemble; The architectural uniqueness of an object; The architectural appearance of the building facades.
Utilitarian	The degree of originality of the architectural and constructive solution; Technological features; The role of the object’s architect in art history; Degree of object’s preservation.

To determine the influence degree of factors from Table 3 on the intangible value of cultural heritage objects, the method of hierarchy analysis [28, 30] has been used and a matrix of priority criteria has been built (Table 4). If, when comparing one factor i with another j , $a(i, j) = b$ is obtained, then when comparing the second factor with the first, $a(j, i) = 1/b$ is obtained. The more important the criterion is, the more integer scores there will be in the corresponding row of the matrix, and the scores have greater values. Next, the geometric mean in each row of the matrix is calculated:

$$a_i = \sqrt[n]{\text{product of elements in a row } i} \tag{4}$$

Geometric means are calculated as:

$$\sum a_i = a_1 + a_2 + \dots + a_n \tag{5}$$

Calculation of the normalized priority vector:

$$\text{component } i = \frac{a_i}{\sum a_n} \tag{6}$$

When compiling a matrix of priority criteria, the expert must answer several questions: “Which one is more important and has the greatest impact?” and “Which one is preferable and has the highest probability?”.

4. Results and Discussion

According to the results of the expert assessment, the priority weight of the criteria was calculated (Table 4).

Table 4. Priority matrix based on experts' evaluation

Criterion/Value	Historical	Urban	Aesthetic	Utilitarian	(II*III*IV*V)/4	Criterion weight
	II	III	IV	V	VI	VII
Priority matrix of an cultural heritage appraiser						
Historical	1	3	1/3	3	1,31607	0,3170
Urban	1/3	1	3	1/3	0,75984	0,1830
Aesthetic	1/3	3	1	1/3	0,75984	0,1830
Utilitarian	1/3	3	3	1	1,31607	0,3170
					4,15182	1,0000
Priority matrix of an architect						
Historical	1	3	1/3	1/3	0,0833	0,0481
Urban	1/3	1	5	3	1,2500	0,7212
Aesthetic	3	1/5	1	1	0,1500	0,0865
Utilitarian	3	1/3	1	1	0,2500	0,1442
					1,7333	1,0000
Priority matrix of an real estate appraiser						
Historical	1	3	1/3	1/3	0,0833	0,0268
Urban	1/3	1	1/3	1	0,0278	0,0089
Aesthetic	3	3	1	1/3	0,7500	0,2411
Utilitarian	3	1	3	1	2,2500	0,7232
					3,1111	1,0000
Priority matrix of manager in historical restoration projects						
Historical	1	1/2	3	3	1,1250	0,6279
Urban	2	1	2	1/2	0,5000	0,2791
Aesthetic	1/3	1/2	1	2	0,0833	0,0465
Utilitarian	1/3	2	1/2	1	0,0833	0,0465
					1,7917	1,0000

Based on the results of the expert assessment, the final priority matrix has been formed (Table 5).

Table 5. Priority matrix based on experts' evaluation

Value indicator	Historical
Historical value	0,2550
Urban value	0,2980
Aesthetic value	0,1393
Utilitarian value	0,3077

As it can be seen that the utilitarian value has the highest weight, urban value is on the second place, and historical and aesthetic values share third and fourth places correspondingly. The developed value indicators system (Table 5) is accompanied by a methodology for a comprehensive evaluation of cultural heritage objects. This methodology is based on a comparative approach with comparison between evaluated objects and similar ones.

Suggested methodology for a comprehensive evaluation of cultural heritage objects includes the following stages:

- Market research and selection of listings (offers for sale) of real estate analogs;
- Collection and verification of information on each analogue object;
- Comparison of each analogue object with the evaluated object via pricing parameters;
- Correction of listing prices for each analogue object with consideration of differences between them and the evaluated object;
- Alignment of the adjusted prices of analog objects;
- Adding the intangible value via value indicators system and the hierarchy analysis method (Table 4).

The non-material value of the objects is estimated by the system of valuable indicators (Table 4) on the basis of method of the analysis of hierarchies. As a result of comparative analysis the similar objects are revealed at the technological level expressed in the corrected cost without non-material factors. The first stage of the method of the analysis of hierarchy is the structuring problem of calculation in the form of hierarchy.

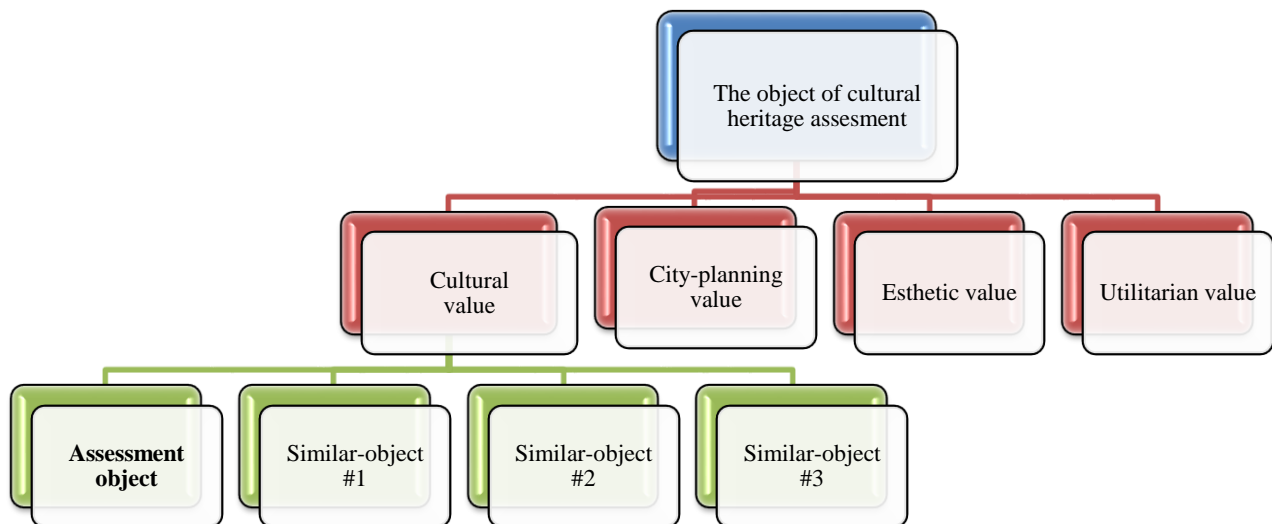


Figure 8. Hierarchy of the assessment of the object of cultural heritage

The second stage is the comparison of extent of the factors (historical, town-planning, esthetic and utilitarian value) influence on the object of the assessment and the similar-objects according to the scale of relative importance. The total matrix of comparison is formed.

Thus, because of the comparative approach different analogous objects with the technical level of design solutions, expressed in adjusted cost, excluding intangible factors can be considered. Intangible factors are taken into account using the hierarchy analysis method. Comparison of the influence degree of intangible factors on the evaluated object and analogue objects on a scale of relative importance, allows forming the final matrix (Table 6).

Table 6. Priority matrix based on experts' evaluation

Criterion/Value	Historical	Urban	Aesthetic	Utilitarian	Weight
I	II	II	III	IV	V
Evaluated object	A	B	C	D	$A*0.2549+B*0.2980+C*0.1393+D*0.3077$
Analogue object №1	X	Y	Z	Q	$X*0.2549+Y*0.2980+Z*0.1393+Q*0.3077$
Analogue object №2	J	L	M	N	$J*0.2549+L*0.2980+M*0.1393+N*0.3077$
Analogue object №3	R	P	S	K	$R*0.2549+P*0.2980+S*0.1393+K*0.3077$

The technological level of the object T is calculated by the following formula:

$$T = \frac{\sum(T_i \cdot K_i)}{(1 - K_0)} \tag{7}$$

Where; T_i: Technological level of the i-th of object analog; K_i: Weight coefficients for the i-th similar object; K₀: Weight coefficient for the estimated object.

As the result of the executed research the valuable indicators of objects of cultural heritage are systematized. It is established that the most priority factor is utilitarian value, then we should consider city-planning value, then historical and esthetic value. The main evaluation stages of technological level of objects of cultural heritage are defined. It is established that the combination of comparative approach and method of the analysis of hierarchies allows to estimate non-material factors of objects of cultural heritage objectively and to consider them correctly and to increase the quality of estimated works.

The comparative analysis of the assessment results of technological level of the objects of cultural heritage received on the basis of the developed technique and earlier known techniques and approaches (see item 2) proved the following:

- The use of standard approaches (cost - effective and profitable method, comparative method) did not allowed to receive objective assessment of technological level of object as qualitative indexes (non-material values) of objects were not considered;
- In practice experts-appraisers are forced to spend time for correction of standard approaches for each estimated object of cultural heritage;
- Because of big share of subjective adjustments there are discrepancies in assessment of technological level of objects of cultural heritage and disputes with the state and bank checking instances, and assessment procedure of objects drags on for an indefinite term.

5. Conclusions

Practical approbation of the evaluation method of technological level of object of cultural heritage was carried out for the memorial building in St. Petersburg). The fragment of the assessment results of technological level of object is given below. Calculation of valuable indicators was made by the means of the method of the analysis of hierarchy. The object of assessment and similar objects were compared on the following factors: historical, town-planning, esthetic and utilitarian values. The results of comparative analysis of objects by means of scale of relative importance (Table 1), are provided in the priority matrixes (Tables 7 to 10).

Table 7. Priority matrix for the historical value

	Object of assessment	Similar object #1	Similar object #2	Similar object #3	Similar object #4	Similar object #5	$(II*III*IV*V*VI*VII)^{1/6}$	Criterion weight
I	II	III	IV	V	VI	VII	VIII	IX
Object of assessment	1	1	5	3	1/3	2	1.4678	0.191
Similar object #1	1	1	5	3	1/3	2	1.4678	0.191
Similar object #2	1/5	1/5	1	1/3	1/6	1	0.3612	0.047
Similar object #3	1/3	1/3	3	1	1/3	3	0.8327	0.108
Similar object #4	3	3	6	3	1	5	3.0531	0.397
Similar object #5	1/2	1/2	1	1/3	1/5	1	0.5054	0.066
							7.6880	1.0000

Table 8. Priority matrix for city-planning value

	Object of assessment	Similar object #1	Similar object #2	Similar object #3	Similar object #4	Similar object #5	$(II*III*IV*V*VI*VII)^{1/6}$	Criterion weight
I	II	III	IV	V	VI	VII	VIII	IX
Object of assessment	1	1/3	5	1/2	3	1/2	1.0379	0.130
Similar object #1	3	1	7	2	5	1/3	2.0301	0.254
Similar object #2	1/5	1/7	1	1/5	1/3	1/7	0.2546	0.032
Similar object #3	2	1/2	5	1	2	1/3	1.2222	0.153
Similar object #4	1/3	1/5	3	1/2	1	1/5	0.5210	0.065
Similar object #5	2	3	7	3	5	1	2.9279	0.366
							7.9937	1.0000

Table 9. Priority matrix for esthetic value

	Object of assessment	Similar object #1	Similar object #2	Similar object #3	Similar object #4	Similar object #5	$(II*III*IV*V*VI*VII)^{1/6}$	Criterion weight
I	II	III	IV	V	VI	VII	VIII	IX
Object of assessment	1	1/3	5	3	1/6	1/2	0.8642	0.104
Similar object #1	3	1	7	5	1/3	1	1.8086	0.218
Similar object #2	1/5	1/7	1	1/3	1/7	1/3	0.2772	0.033
Similar object #3	1/3	1/5	3	1	1/5	1/3	0.4870	0.059
Similar object #4	6	3	7	5	1	3	3.5162	0.424
Similar object #5	2	1	3	3	1/3	1	1.3480	0.162
							8.3012	1.0000

Table 10. Priority matrix for utilitarian value

	Object of assessment	Similar object #1	Similar object #2	Similar object #3	Similar object #4	Similar object #5	$(II*III*IV*V*VI*VII)^{1/6}$	Criterion weight
I	II	III	IV	V	VI	VII	VIII	IX
Object of assessment	1	1/3	2	1	1/4	3	0.8909	0.117
Similar object #1	3	1	4	2	1/2	5	1.9786	0.260
Similar object #2	1/2	1/4	1	1/3	1/5	1/2	0.4011	0.053
Similar object #3	1	1/2	3	1	1/3	1	0.8909	0.117
Similar object #4	4	2	5	3	1	5	2.9042	0.382
Similar object #5	1/3	1/5	2	1	1/5	1	0.5466	0.072
							7.6123	1.000

The total matrix of valuable indicators (Table 11) is given below and the technological level of the studied object is calculated by Equation 7.

Table 11. Total matrix of the studied object

	Historical value	City-planning value	Esthetic value	Utilitarian value	C
I	II	III	IV	V	VI
Object of assessment	0.91	0.130	0.104	0.117	0.138
Similar object #1	0.191	0.254	0.218	0.260	0.235
Similar object #2	0.047	0.032	0.033	0.053	0.042
Similar object #3	0.108	0.153	0.059	0.117	0.117
Similar object #4	0.397	0.065	0.424	0.382	0.297
Similar object #5	0.066	0.366	0.162	0.072	0.171
	1.0000	1.0000	1.0000	1.0010	1.000

Technological level of the estimated object:

$C = (0.235 \cdot 362\,472 + 0.042 \cdot 235\,829 + 0.117 \cdot 232\,431 + 0.297 \cdot 306\,313 + 0.171 \cdot 308\,643) / (1 - 0.138) = 254,899$ rubles sq. meter.

The received results of the assessment of technological level of the studied object are recommended for the use at transactions in the real estate market:

- For the purpose of purchase sale/privatization of object;
- For transfer object in lease or pledge;
- For insurance of object;
- For crediting;
- When entering into the authorized capital of the company;
- During business valuation;
- For the purposes of taxation;
- By reorganization and privatization of the enterprise;
- For permission of receivership proceeding;
- For the acceptance of various management decisions (for calculation of cost of restoration of objects of cultural heritage).

Users of the developed technique can include: appraisers of the real estate, appraisers of business, owners of object of cultural heritage, specialists of mortgage department of bank, specialists of insurance companies, developers who are engaged in management of similar objects, construction companies which are engaged in restoration of similar objects.

Based on the results of the study, the main conclusions have been formulated in the following way:

- The value indicators system allows forming an integrated approach to evaluation of the design solution technical level of different cultural heritage objects;
- The developed methodology takes into account the tangible (material) and intangible (historical and cultural) factors of the evaluated object;
- The combination of a comparative approach and the hierarchy analysis method in the evaluation of the design solution technical level allows adequately assessing intangible factors and improve the quality of evaluation process;
- The methodology for a comprehensive evaluation can be applied in the real estate market in various types of transactions.

6. Declarations

6.1. Author Contributions

L.L. developed the methodology of the complex assessment of the technological level of objects of cultural heritage on the basis of comparative approach and method of the analysis of hierarchies; S.T. systematized the physical (material) and non-material (historical and cultural) factors of the assessment object, developed the system of

valuable indicators of objects of cultural heritage; L.T. developed the algorithm of the object assessment and the matrix of priority. All authors have read and agreed to the published version of the manuscript.

6.2. Data Availability Statement

The data presented in this study are available in article.

6.3. Funding

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6.4. Conflicts of Interest

The authors declare no conflict of interest.

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