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Vitality evaluation of historical and cultural districts based on the values dimension: districts in Beijing City, China

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Abstract

Historical and cultural districts are an important part of the urban heritage environment, reflecting the urban characteristics and carrying the core value of urban development. At present, most of the research on the vitality of historical and cultural districts mainly carries out quantitative evaluation from the two aspects of material space and time dimension, while the analysis on the value level is weakened, and the content of value type evaluation is also ignored. Value is the main factor affecting the vitality of historical and cultural districts, and it is also the core content to keep them alive. Therefore, this study takes nine historical and cultural districts of three types (cultural, commercial and residential) in Beijing, the capital of China, as examples to form a vitality evaluation framework with value as the evaluation goal, and select three indicators: historical value (including historical environment, cultural environment and spatial environment), use value (including communication environment, business environment and residential environment) and sustainable value (including educational environment, attraction and creativity), which correspond to the past, present and future of the heritage respectively. The literature summary method is used to get the evaluation content, the ranking analytic hierarchy process is used to determine the index weight, experts are invited to score, and the influence degree of each factor is comprehensively ranked and analyzed. Finally, it puts forward the evaluation system of historical and cultural districts. The framework can be used to collect expert opinions, conduct quantitative value evaluation, and adjust various indicators in practice before the protection strategy of historical and cultural districts is proposed. The results show that at present, Shichahai, Nanluoguxiang and Fuchengmennei have the highest vitality among the three types. The blocks that mainly embody cultural value have higher vitality than those that mainly embody commercial value and residential value.

Keywords: Vitality evaluation, Historical districts, Cultural districts, Values dimension, Beijing

Introduction

Historical and cultural districts refer to areas with rich cultural relics, concentrated historical buildings, which can more completely and truly reflect the traditional pattern and historical style, and have a certain scale [1]. They are also known as Urban Historic Conservation Areas [2]. As one of the largest urban public spaces, historical

and cultural districts carry important urban memory and are highly related to the sustainable development of the city [3]. The vitality of the block is an important indicator of its integration into contemporary life [4]. If historical and cultural districts have vitality, they can have more attraction [5]. The vitality of the block is usually reflected in the state of people's activities in the street [6]. Jane Jacobs believes that the vitality of the block is related to the length and width of the street, the density of pedestrians and the age of the building [7]. Gehl, J studied the relationship between the vitality of historical blocks and traffic conditions [8]. Montgomery, J, believes that the

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scale and connectivity of streets can affect spatial vitality [9]. It can be seen that the vitality of historical and cultural districts is reflected in the material space of streets, which can be used as one of the factors to evaluate the vitality of historical and cultural districts [10].

There are a lot of studies on taking material space as the vitality evaluation of historical and cultural districts [11]. Material space not only includes the space proportion and architectural form of the street, but also the enclosure, transparency and complexity of the street [12]. In addition, the built environment of historical and cultural districts also has a direct impact on its vitality, including pedestrian activity track [13], thermal radiation, urban heat island environment, street greening ecosystem, street lighting system, car parking environment, etc. The material space elements and built environment elements of these historical and cultural districts provide objective and quantifiable indicators for their vitality evaluation [14].

At present, the quantitative methods for the vitality evaluation of historical and cultural districts include spatial grid method, analytic hierarchy process, sequential relationship analysis method, GIS analysis method [15], multiple regression analysis method and so on [16]. These analysis methods classify, count and simulate the space in the districts. Historical and cultural districts are usually divided into two dimensions: external material space needs, internal activities and communication needs. There is also a dimension of time given to the evaluation of street vitality, that is, to comprehensively evaluate the vitality of the street from different time periods and different crowd activity trajectories. In the current evaluation system, the influence of value factors is also considered [17]. But it doesn't put value first, and there is no systematic research on the value dimension.

In order to fill the research gap, the aim of this article is to evaluate the vitality of historical and cultural districts from the perspective of value. There are three deficiencies in the current research. First, there is no time classification of all heritage values; second, there is no evaluation of historical and cultural districts in terms of value; third, there is no systematic evaluation method to evaluate the vitality of historical and cultural districts from the value. In view of the shortcomings of the current research, this study has two purposes: one is to classify the heritage value of different historical and cultural districts; the second is the systematic evaluation and understanding the vitality of historical and cultural districts from the perspective of value. These two research purposes will explain that value can reflect the vitality of historical and cultural districts, but also affect the vitality. At the same time, from the perspective of heritage protection, value also represents vitality.

Value factor is the key to evaluate historical and cultural heritage [18]. From the contemporary view towards conservation, the major issue is to conserve values [19]. And the objective basis for the formation of cognition also comes from the value of heritage itself [20]. The Venice Charter points out that heritage value is not only historical value and artistic value, but also involves the scientific value of heritage [21]. People are increasingly aware of the importance of the sociality of heritage [22]. Burra Charter puts forward that in addition to history, art and science, the type of heritage value adds a social item, covering spiritual, political, national, educational and other cultural values [23]. In addition, heritage value is divided into intrinsic value and instrumental value [24]. The former includes aesthetics, spirit, history, symbol, community/individual recognizability, authenticity and value [25]; the latter includes economic tourism, business and related industries, possible changes in the education industry and possible social changes [26]. These classification methods are analyzed from different angles, and we believe that value can be classified in the dimension of time. The design of the existing value type does not adapt to the vitality of the block. There is very little research on the "time classification of value". The time classification of value refers to the concept of giving value to the past, present and future. About the past, it is the historical value of heritage. About now, it is the use value. About the future, it is sustainable value. This classification comes from the value itself. Among them, historical value also includes the symbolic significance of history, art, science, aesthetics and emotion. The use value is the role of heritage as a social resource invested in social development and undertaken in modern society. Such as education, culture and leisure, tourism, production, life and other social functions. The rational use of heritage resources will bring various economic and social benefits to the society. And about sustainable heritage values. It is generated by group participation and interaction in Heritage related services and activities. The classification is carried out around the social role of heritage, and it also examines the possible categories of heritage value from three angles. Therefore, value can not only affect vitality, but also reflect vitality.

The original or new contribution of the study are as follows: (1) Propose a framework to evaluate the vitality of historical and cultural districts from the dimension of value. (2) Apply historical value (including historical environment, cultural environment and spatial environment), use value (including communication environment, business environment and residential environment) and sustainable value (including educational environment, attraction and creativity) to comprehensively analyze the vitality of historical and cultural districts. (3) Provide a

systematic method to compare the weights of different elements in heritage value. (4) From the perspective of value, it provides a full cycle perspective of public participation for the vitality evaluation of historical and cultural districts. This study will provide a valuable perspective for the conservation practice of historical and cultural districts. It also provides an evaluation method for summarizing expert opinions before the protection practice project. In the practice of improving the vitality of historical and cultural districts, we can also provide methods for sorting various indicators, and then find the indicators that need to be improved.

Literature review

The literature review includes three aspects. The first aspect is the previous research on the vitality evaluation of streets. The second aspect is the discussion of value evaluation research, which is mainly related to vitality evaluation. The third aspect is the classification of value for historical and cultural districts.

In recent years, the quality of urban space has been paid attention to, so there are a lot of studies on the vitality of urban space, including urban streets [27], waterfront space [28], square space [29] and so on. These diverse spaces constitute the urban space and the material basis of urban vitality [30]. These spaces are the social space of human activities and the vitality of these spaces also determines the vitality of the city [31]. Chang Xia, Anqi Zhang and Anthony G. O. Yeh examined the relationships between multidimensional urban form and urban vitality at the street block level and explore their variations across fifteen megacities in China [32]. As a unique identification space of a city, historical blocks emphasize the historical and cultural value of streets. There are many types of spaces, such as streets, squares, waters, landscapes, transportation and so on [15]. The vitality of historical and cultural blocks has also been studied from different perspectives by scholars [33]. It can be roughly divided into buildings, road type, pedestrian environment, street greening and parking lot: Mahmoudi et al. assess the vitality of the streets through the shape, density, continuity and height and width of the buildings [34]. Wanshu Wu et al. evaluate the impact of building environment on street vitality [35]. Ikioda studied the impact of road system on street vitality and the impact of the proportion of roads at different levels on people's travel [36]. Xin Li et al. studied the influence of strip-city street network structure on spatial vitality [37]. Zarin et al. introduced that a suitable walking environment can enhance the vitality of the street [38]. In addition, optimizing the urban landscape can enhance the vitality of the street and city [39]. Ajeng and Gim studied the parking problem in the street, analyzed the differences

of parking in different periods of time, and the impact of parking space on street vitality [40]. Moreover, Li Miao et al. summarized the five components of the vitality of historical blocks as material space vitality, social vitality, cultural vitality, economic vitality and political vitality [41]. Siavash Jalaladdini and Derya Oktay analysis indicators of street vitality include social attributes, namely user types, social groups, various activities, active time, interaction and safety, as well as physical attributes, namely physical form and street comfort. In addition, they also studied the space and various functions in the street [42].

However, for historical and cultural districts, it can more completely and truly reflect the traditional pattern and historical style of a city. Protection of historical features is now widely considered an inherently values-based activity that can be understood as an expression of values [43]. Therefore, the vitality evaluation of historical streets should put more emphasis on value. Feilden B. believes that recognizing the historical information conveyed by the goal is the first step, so the value evaluation is the main aspect of the vitality evaluation of historical blocks [44].

In the current research, value evaluation is mainly used for Heritage Management and heritage protection. Throsby D believes that decisions on heritage management are usually made based on some evaluation of the value of heritage projects [45]. Jingfu et al. evaluated the value of heritage in the practice of heritage protection [46]. The purpose of value evaluation is to fully understand and give full play to the historical value of the heritage, so that it can better serve the present while transmitting historical information, and make its value be expressed sustainably in the future. The understanding of the past, present and future of heritage is the embodiment of its full cycle vitality. It can be seen that value recognition is an important part of vitality and vitality evaluation. In the current research, the value factor is also considered in the evaluation of street vitality, and the value is taken as one of the evaluation indicators [47].

The third part is about the classification of value. 40 values were identified to identifying the semantic values of the historical heritage. These values are: cultural value, economic value, identity, historical value, integrity, aesthetic value, authenticity, contextual value, heritage value, spiritual value, functional value, uniqueness value, scientific value, architectural value, symbolic value, pride value, universal value, conflicting values, conflicting values, bequest value, humanistic value, individual value, visualization value, recreational value, political value, psychological value, rarity value, educational value, dominant opinion, grandeur value, acquired values, emotional value, donor's

value, demolishing value, unwanted heritage, archaeological value, moral value, tourist's value, scenic value, local's value and resilience value [48]. Rudolff suggests that 'the immense variety of value categories offered in academic and non-academic writings in the heritage field. And L. Harald Fredheim and Manal Khalaf discussed the design of value types from the perspective of heritage protection and management and build a typological framework for holistic values-based approaches [49]. As for the value of historical and cultural blocks, they are different from ordinary urban streets. The object of its protection is a living and used neighborhood, so its protection policy is different from that of cultural relics. Therefore, the classification of the value of historical and cultural blocks should be carried out from the perspective of time. The historical value is the past, and the use value is the present. The purpose of protecting it is to make it sustainable, and the sustainable value is the future. The definitions of these three values are presented in the following.

1. Historical value: The definition of historical value is the product of human social activities in a certain historical period, which can show the relevant aspects of human history [50]. It can prove, correct or supplement historical documents [51]. Historical and cultural blocks can not only be a witness of history, but also reflect the value of traditional culture in cities and towns. The Washington charter lists the contents that should be protected in historical blocks: the pattern and spatial form of lots and streets; The spatial relationship between buildings and greening and open land; The internal and external appearance of historic buildings, including the relationship between the volume, form, architectural style, materials, architectural decoration and the surrounding environment, including the relationship with the natural and artificial environment; Historical functions and functions of the site [52]. Therefore, the environment that can reflect the historical value can be summarized as: historical environment, cultural environment and spatial environment [53]. The historical environment includes the pattern of lots and streets, that is, street texture [25]. It includes historical buildings, that is, the internal and external features of historical buildings. In addition, it also includes historical features, referring to the functions and functions of streets, buildings and streets. Cultural environment includes integrity, scarcity and aesthetic value. Space environment refers to the space enclosed by buildings and streets, including building density, building floor area ratio and street height width ratio.

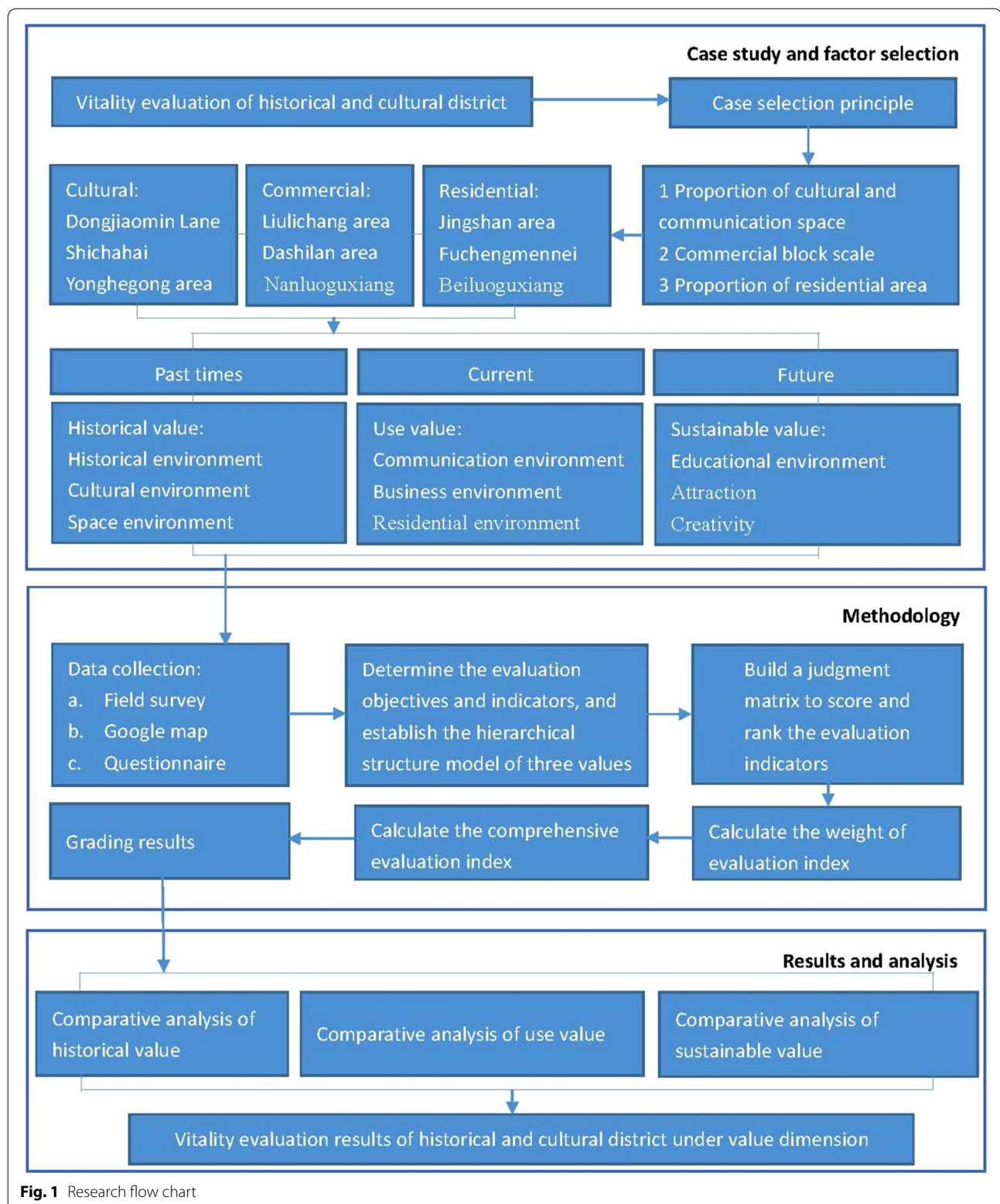
2. Use value: Use value belongs to economics, which refers to the utility of goods that can meet people's certain needs [54]. Historical and cultural blocks meet the needs of contemporary people for communication, business activities and residence [55]. Therefore, the content of use value includes communication environment, business environment and residential environment.
3. Sustainable value: Sustainable value refers to the continuation of certain characteristics [56]. The sustainable value of historical and cultural blocks is to inherit the history and culture of the space, so the sustainable value includes educational environment, attraction and creativity [57]. Educational environment is a place for public interaction and cognition. Attractiveness is to enhance public participation and the stability of the overall environment to maintain its attractiveness. Creativity is to encourage the transformation of academic achievements and innovative services.

Methodology

Overview of methodology

Figure 1 shows the framework and process of the whole study. In the first step, the article selects nine historical and cultural districts in Beijing, China according to three types: cultural, commercial and residential, and the selection standard is the proportion of different types of functions. The vitality of these districts is analyzed from three aspects: historical value, use value and sustainable value. These three values correspond to the past, present and future of value respectively. It provides a framework for dealing with time and change. For example, if the value of a historical area is determined today, and some differences appear 20 years later, what do these changes mean to the value of this place? Therefore, the value type must solve the problem of time. Each value corresponds to three sub factors.

The second step is to list the hierarchical model diagram of the three target values after collecting the data from on-site investigation and expert interview. And ranking and analyzing the importance degree according to the score of experts. Analytic hierarchy process refers to a systematic method that takes a complex multi-objective decision-making problem as a system, decomposes the goal into multiple goals or criteria, and then decomposes it into several levels of multiple indicators, and calculates the hierarchical single ranking and total ranking through the fuzzy quantitative method of qualitative indicators, so as to be used as the objective and multi scheme optimization decision-making. This method is often used to evaluate the value and attractiveness of

**Fig. 1** Research flow chart

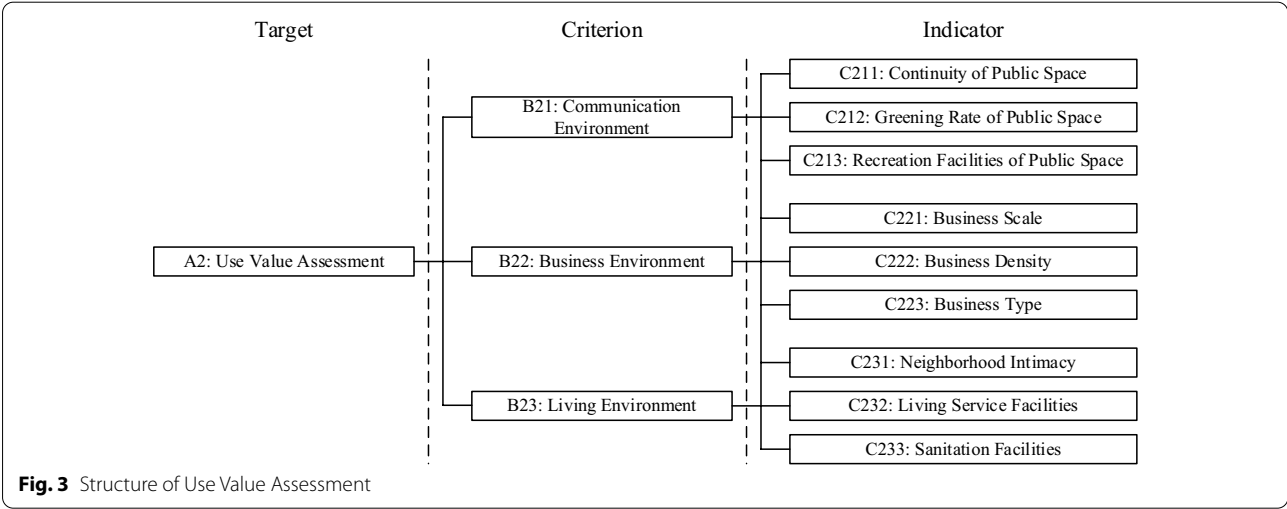
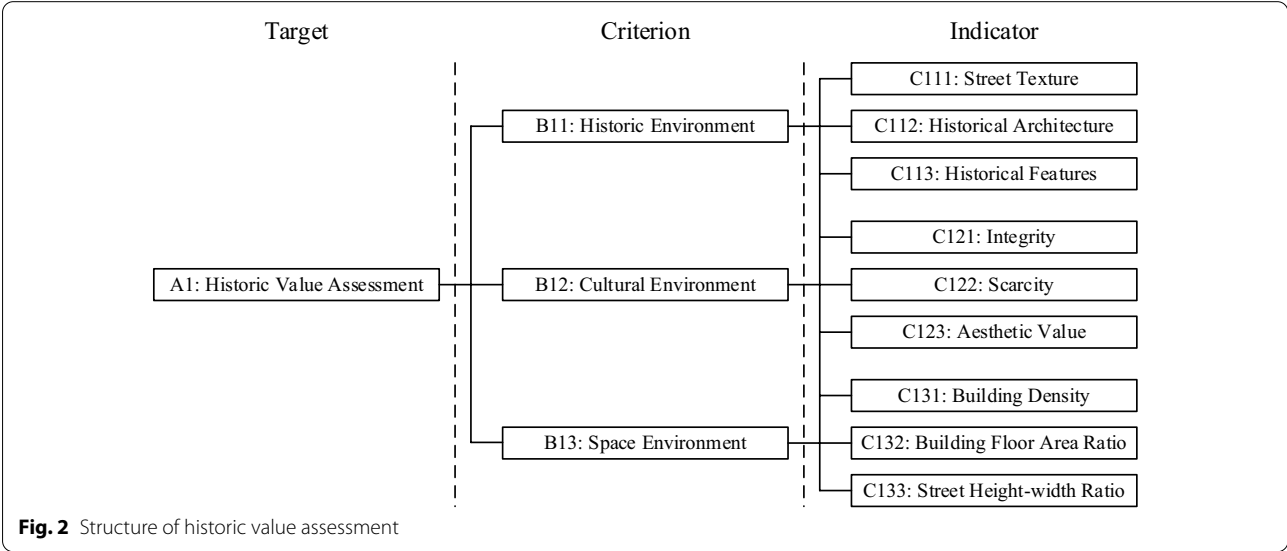
heritage [58]. Ma h et al. used this method to evaluate the value of heritage buildings [59]. Turskis Z et al. used this method to carry out multi criteria side ranking of heritage value [60]. Jiang P et al. used this method to analyze the value advantages of Railway Heritage [61]. And Xu Y et al. used this method in the social value evaluation related to the heritage value [62]. In short, the method takes the research object as a system and makes decisions according to the thinking mode of decomposition, comparative judgment and synthesis. This study takes vitality as the goal, decomposes it from the perspective of value, and sorts and analyzes it in the way of expert consensus.

Finally, three aspects are analyzed: (1) comprehensive ranking of three values of 9 districts; (2) Rank the three values for each type of district; (3) Rank each target value in different types of districts. This study provides a

direction for the improvement and development of historical and cultural districts.

Evaluation index

The assessment system consists of three hierarchies: A-target, B-criterion and C-indicator. A1, A2 and A3 correspond to the historic value assessment, the use value assessment and the sustainable value assessment respectively (Figs. 2, 3, 4). The evaluation criteria and their indicators were determined by expert consensus to evaluate vitality of nine historical and cultural districts. For the historic value assessment, three type criterions were adopted: historic environment, cultural environment and space environment. In the use value assessment, communication environment, business environment and living environment were selected as criteria. In the sustainable



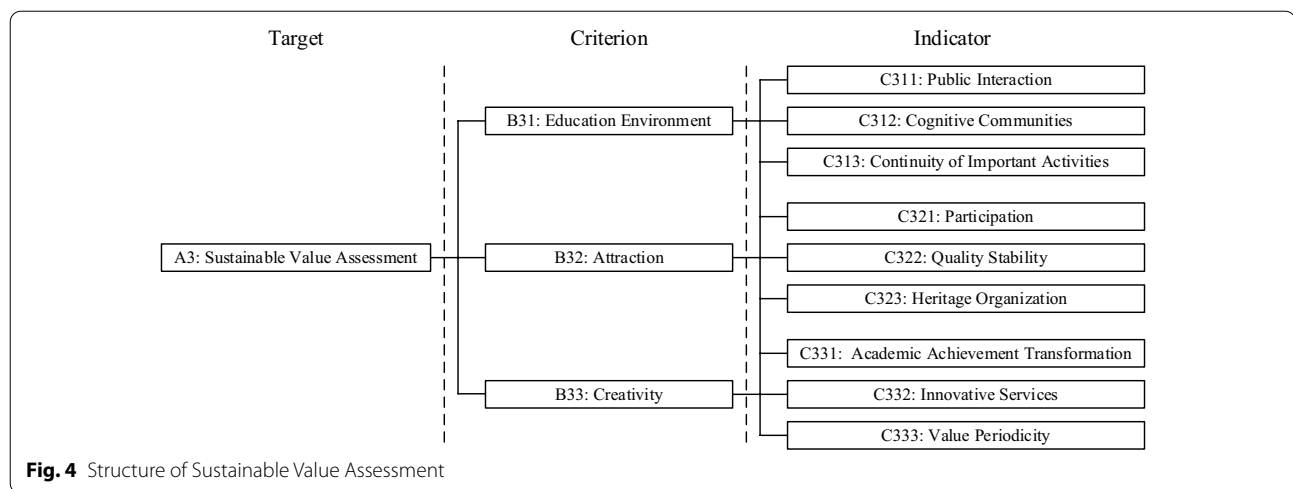


Fig. 4 Structure of Sustainable Value Assessment

value assessment, education environment, attraction, and creativity were included in the criteria. The following is the explanation of each indicator:

C111 Through building type, roof form and material, facade style, building height, building density, greening, open space and other elements, it is specifically reflected in the two-dimensional space. C112 Buildings that can reflect historical features and local characteristics. C113 It refers to the overall appearance of the natural and human environment of the street, which reflects the historical and cultural characteristics. C121 The unchanged part of the historical characteristics of the street. C122 Unique culture. C123 Artistic characteristics. C131 It refers to the proportion between the total base area of buildings and the occupied land area within a certain range. Other parts are used for roads, greening, squares, parking lots, etc. C132 Ratio of the total building area of various buildings above the ground to the base area. C133 Ratio of height of street buildings to street width.

C211 Layout of public spaces such as squares on both sides of the street. C212 Greening degree of public space. C213 Number and style of recreational facilities in public space. C221 Number of commercial buildings and facilities. C222 Density of commercial buildings and facilities. C223 Types of commercial buildings and facilities. C231 Communication environment between neighbors. C232 Living service sharing facilities. Outdoor seats, etc. C233 Toilets, garbage cans and other sanitation facilities.

C311 Square for public activities. C312 Activities of primary and secondary school students, tourists, photographers and other groups in the block. C313 Important activities in the region, such as praying for blessings in Yonghegong district. C321 Public activity space, such as skiing in Shichahai area every winter. C322 Style and features, facilities, activities and other factors of the block

remain in a state. C323 Level of heritage. C331 Literature about each blocks. C332 New activities about historical and cultural districts, such as the logo design of block. C333 The ages of historical sites and buildings in historical blocks.

The targets, the criteria and the indicators were ordered by the consensus of twenty experts, and the weights of the targets, the criteria and the indicators were determined by the order relation analysis method. Authority and representativeness are the basic principles for selecting consensus experts. To guarantee that experts are familiar with Beijing's urban history and changes, the twenty experts were selected from Beijing think tank related to the Beijing central axis application for world heritage, and their majors were in Beijing history, architectural history, landscape, urban planning, and the other eight from Beijing cultural tourism department. The standard for selecting experts is to have senior professional titles, a certain popularity, and more than 10 years of working experiences. Finally, the values were computed through the following formula:

$$\begin{aligned} &\text{Vitality value of each district} \\ &= (\text{value of target A1}) \times \text{weight A1} \\ &\quad + (\text{value of target A2}) \times \text{weight A2} \\ &\quad + (\text{value of target A3}) \times \text{weight A3} \end{aligned} \quad (1)$$

Through the order relation analysis method, the values of the weights were calculated by using an r_k scale from 1.0 to 1.8 to judge the relative importance of each target, each criterion and each indicator. The r_k is the ratio of the weight w_{k-1} of factor x_{k-1} to the weight w_k of factor x_k as follows:

$$r_k = w_{k-1}/w_k, \quad k = 2, 3, \dots, n \quad (2)$$

The significance of the r_k scale is shown in Table 1. Firstly, the weight w_n is calculated in terms of the r_k evaluated with experts for each target, each criterion and each indicator.

$$w_n = \left(1 + \sum_{k=2}^n \prod_{i=k}^n r_i \right)^{-1} \quad (3)$$

Then, the weights $w_{n-1}, w_{n-2}, \dots, w_1$ were calculated using the Eq. (4). Through the order relation analysis method, the weights of each target, each criterion and each indicator were obtained as shown in Table 2.

$$w_{k-1} = r_k w_k, \quad k = 2, 3, \dots, n \quad (4)$$

Lastly, the comprehensive weight of each indicator was calculated using the Eq. (5).

$$\begin{aligned} &\text{Comprehensive weight of indicator } C_{ijk} \\ &= (\text{weight } w_{ij} \text{ of criterion } C_{ij}) \times (\text{weight } w_{ijk} \text{ of indicator } C_{ijk}) \end{aligned} \quad (5)$$

Table 1 Significance of the r_k scale

r_k	Significance
1.0	Factors x_{k-1} and x_k are of equal importance
1.2	Factor x_{k-1} is slightly more important than factor x_k
1.4	Factor x_{k-1} is significantly more important than factor x_k
1.6	Factor x_{k-1} is intensely more important than factor x_k
1.8	Factor x_{k-1} is extremely more important than factor x_k

Case study of nine districts

The nine historical and cultural districts are selected according to the three types of districts (Table 3). These three types are divided based on the three main functions of historical and cultural blocks. The first type is cultural blocks, which are characterized by distinctive

Table 2 Weights of target A, criterion B and indicator C

Target	Weight	Criterion	Weight	Indicator	Weight	Comprehensive weight
A1	0.4118	B11	0.3956	C111	0.4041	0.1599
				C112	0.3368	0.1332
				C113	0.2591	0.1025
		B12	0.3297	C121	0.2541	0.0838
				C122	0.3431	0.1131
				C123	0.4118	0.1358
		B13	0.2747	C131	0.2577	0.0708
				C132	0.3093	0.0850
				C133	0.4330	0.1189
A2	0.3431	B21	0.3684	C211	0.3956	0.1457
				C212	0.3297	0.1215
				C213	0.2747	0.1012
		B22	0.2632	C221	0.4500	0.1184
				C222	0.2500	0.0658
				C223	0.3000	0.0790
		B23	0.3684	C231	0.2294	0.0845
				C232	0.4495	0.1656
				C233	0.3211	0.1183
A3	0.2451	B31	0.4118	C311	0.2427	0.0999
				C312	0.4660	0.1919
				C313	0.2913	0.1200
		B32	0.3431	C321	0.3297	0.1131
				C322	0.3956	0.1357
				C323	0.2747	0.0942
		B33	0.2451	C331	0.2451	0.0601
				C332	0.4118	0.1009
				C333	0.3431	0.0841

Table 3 General information of 9 historical and cultural districts

	Name	Type	Location	Date of construction	Features
1	Dongjiao Minxiang	cultural	It starts from Tiananmen Square East Road in the West and ends at chongwenmennei street in the East	About 1860	The total length is 1552 m. It was once a famous embassy area. After the second Opium War in 1860, Britain, France, the United States, Russia, Japan, Germany, Belgium and other countries successively set up embassies in dongjiaomin lane
2	Shichahai	cultural	It starts from the north side of di'anmenwai street in the East, Xijiekou North Street in the south, Xijiekou gap in the west, and bell and drum towers in the north	About 1644	With a water area of 336,000 square meters, it is an open scenic spot with open water in the inner city of Beijing, and it is also a historical block with the largest area and the most complete style preservation in Beijing
3	Yonghegong district	cultural	It starts at the intersection of Beixinqiao in the south, and ends at the North Second Ring Road in the north. It is connected with Beixinqiao Toutiao, theater Hutong and other hutongs in the East, and wudaoying Hutong and other hutongs in the West	About 1947	Yonghe temple was built in 1694. This area is a block with a concentration of important temple buildings and important cultural relics in the old city of Beijing
4	Liulichang	commercial	Outside the Hepingmen in Beijing	About 1736	About 800 m long. A center for the acquisition and sale of traditional cultural works
5	Dashilan	commercial	Outside Qianmen, Beijing	About 1420	Length 275 m. 43 hundred year old shops. Dashilan was once an entertainment center in the capital, and there were once five big theatres. The earliest cinema in Beijing is also located here
6	Nanluoguxiang	commercial	Located at the intersection area on the east side of the central axis of Beijing, it starts from Gulou East Street in the north and ends at Di'anmen East Street in the south	About 1750	787 m long and 8 m wide. It is a traditional residential area with the largest scale, the highest grade and the most abundant resources, which has completely preserved the texture of the Hutong courtyards of the Yuan Dynasty in China, and it is also the street with the most old Beijing style
7	Jingshan	Residential	With Jingshan as the center, it starts from Ping'an Avenue in the north and ends at the north wall of the Forbidden City in the south	About 1914	In the Ming Dynasty, this area became a concentrated area of institutions directly serving the royal family and official handicrafts. After the Qing Dynasty, it gradually became a residential block, with many cultural relics and buildings
8	Fuchengmennei	Residential	It starts from Xisi South and North streets in the East, Fuchengmen Second Ring Road in the west, and Xisi North Toutiao in the north	About 1439	There are cultural relics protection units such as Miaoying temple, Lu Xun's old residence, emperors' temple of previous dynasties, Guangji temple, etc. in the protection block; 47 groups of historic buildings. There are 45 ancient and famous trees
9	Beiluoguxiang	Residential	It starts from Andingmen West Street in the north and ends at Gulou East Street in the south	Qing dynasty	With a total length of 866 m and a width of 7 m, together with many hutongs, it is now a residential function

cultural characteristics. At the same time, the proportion of cultural buildings is also the highest. The three most representative blocks are Dongjiao Minxiang, Shichahai and Yonghegong district. Dongjiao Minxiang is a famous embassy district in modern times after the second Opium War in 1860, Britain, France, the United States, Russia, Japan, Germany, Belgium and other countries successively set up embassies in dongjiaomin lane, and renamed dongjiaominxiang as embassy street. It is a European style block integrating embassies, churches, banks, official residences and clubs. The existing buildings are preserved in the original state, maintaining the eclectic style popular in Europe and America at the beginning of the twentieth century. The moldings and pilasters are built with plain bricks, brick arches and verandas, wooden corner purlins, and iron roof slopes. It is the only western style architectural complex in Beijing in the early twentieth century. Shichahai is the largest and best preserved historical district in Beijing. It plays an important role in Beijing's cultural history, mainly represented by Prince Gong's mansion and garden, Song Qingling's former residence and Lord Chun's mansion, Guo Moruo memorial hall, bell and Drum Tower, Deshengmen arrow tower, Guanghua temple, Huitong temple and Huixian hall. There are many distinctive folk activities in Shichahai Area, such as releasing lotus lanterns, boating around the lake, feasting and enjoying the lotus, drinking around the ice bed, reading skates, etc. Some vigorous folk activities still exist in Shichahai Area. Such as fishing, swimming, boating, rowing, playing chess, singing, summer dance, etc. "Hutong Tour" is active in this unique natural and cultural environment. Yonghegong district is a block with a concentration of important temple buildings and important cultural relics in the old city of Beijing, including the Imperial College, Confucius Temple,

Imperial College Street, Lama Temple, Berlin Temple, etc. The second type is the commercial historical districts, which is selected based on the large scale and rich types of business. The three blocks with large commercial scale and rich types are Liulichang, Dashilan and Nanluoguxiang. Liulichang has many famous old stores, as well as China Bookstore, the largest antique bookstore in China. Dashilan has been a business district since 1420. And Nanluoguxiang is the area with the most complete preservation and the most concentrated quadrangles in the old city of Beijing at present. The third type is residential historical districts, and the function of these areas is mainly residential. Typical residential districts are Jingshan, Fuchengmennei and Beiluoguxiang district. These three historical blocks with residential functions are characterized by the concentration of residential houses with Beijing characteristics. Based on field observation and measurement, this study collected the basic data of the field and the evaluation results of experts for analysis.

Twenty of the experts scored the indicator for nine districts as shown in Tables 4, 5. The nine districts are ①Dongjiao Minxiang ②Shichahai ③Yonghegong district ④Liulichang ⑤Dashilan ⑥Nanluoguxiang ⑦Jingshan ⑧Fuchengmennei ⑨Beiluoguxiang. In Tables 4, 5, the allocation scores were obtained by comprehensive weights multiplied by 100. According to the standards in Table 6, the experts scored the nine blocks, and each index was divided into five levels from high to low.

To justify the reliability of each target separately (A1, A2 and A3), the Cronbach's alpha of target A_j is used to clarify its reliability according to the Eq. (6) where K equals 9, $S_{A_j,i}^2$ represents the variance of the value of indicator i of target A_j , $S_{A_j}^2$ represents the variance of sum of all index values of target A_j . Through the calculation the Cronbach's alphas of targets A1, A2 and A3 are 0.732,

Table 4 Indicator score of nine districts for historic value assessment

Criterion	Indicator	Allocation scores	Score of experts								
			①	②	③	④	⑤	⑥	⑦	⑧	⑨
B11	C111	16	12	16	14	9	10	13	15	13	12
	C112	13	10	9	12	5	6	8	5	7	6
	C113	10	9	7	9	6	5	6	6	3	6
B12	C121	8	6	5	8	8	6	7	6	5	5
	C122	11	7	9	11	10	8	7	7	6	5
	C123	14	11	12	13	6	7	10	12	10	9
B13	C131	7	4	5	7	6	5	4	3	5	4
	C132	9	6	8	9	8	7	7	6	7	7
	C133	12	7	6	10	10	7	9	6	7	9
			72	77	93	68	61	71	66	63	63

0.791, and 0.750 respectively and the research data have desirable reliability.

$$\alpha_{A_j} = [K/(K-1)] \left(1 - \sum S_{A_{ji}}^2 / S_{A_j}^2 \right),$$

$$j = 1, 2, 3, i = 1, 2, \dots, K \quad (6)$$

According to the indicator score of nine districts, the vitality value was calculated using the Eq. (1). The calculation results were 74.79 for Dongjiao Minxiang, 83.13 for Shichahai, 87.41 for Yonghegong district, 75.30 for Liulichang, 74.48 for Dashilan, 77.57 for Nanluoguxiang, 71.98 for Jingshan, 64.03 for Fuchengmennei, 62.36 for Beiluoguxiang.

Results

Comparative analysis of historical value

The historical value of historical and cultural districts has specific historical conditions and characteristics of the times. It includes historical environment, cultural environment and spatial environment. The results show that the most closely related to historical value is street texture. The second is historical architecture and aesthetic value (Table 2). Historical and cultural districts with good street texture, rich historical buildings and high aesthetic value have high historical value. The historical values of the 9 historical and cultural blocks are ranked as follows: ③Yonghegong district, ②Shichahai, ①Dongjiao Minxiang, ⑥Nanluoguxiang, ④Liulichang, ⑦Jingshan, ⑧Fuchengmennei, ⑨Beiluoguxiang, ⑤Dashilan (Table 5). The ranking of the historical values of these nine districts also reflects the relationship with different types of districts. Cultural districts usually have high historical value because they are excellent in street texture, historical buildings and historical characteristics. The historical value of commercial and residential historical districts is not very significant.

The cultural environment and spatial environment in historical value also reflect different degrees of importance in different types of historical and cultural districts. Cultural environment mainly includes integrity, scarcity

Table 6 score-determined standard

Indicator	Allocation scores	Evaluation Criteria
C111	16	I:16, II:12, III:8, IV:4, V:0
C112	13	I:13, II:10, III:7, IV:4, V:0
C113	10	I:10, II:8, III:6, IV:3, V:0
C121	8	I:8, II:6, III:4, IV:2, V:0
C122	11	I:11, II:8, III:5, IV:3, V:0
C123	14	I:14, II:11, III:8, IV:4, V:0
C131	7	I:7, II:5, III:3, IV:2, V:0
C132	9	I:9, II:7, III:5, IV:3, V:0
C133	12	I:12, II:9, III:6, IV:3, V:0
C211	15	I:15, II:11, III:7, IV:3, V:0
C212	12	I:12, II:9, III:6, IV:3, V:0
C213	10	I:10, II:8, III:6, IV:3, V:0
C221	12	I:12, II:9, III:6, IV:3, V:0
C222	6	I:6, II:5, III:3, IV:1, V:0
C223	8	I:8, II:6, III:4, IV:2, V:0
C231	8	I:8, II:6, III:4, IV:2, V:0
C232	17	I:17, II:12, III:8, IV:4, V:0
C233	12	I:12, II:9, III:6, IV:3, V:0
C311	10	I:10, II:8, III:6, IV:3, V:0
C312	19	I:19, II:14, III:9, IV:4, V:0
C313	12	I:12, II:9, III:6, IV:3, V:0
C321	11	I:11, II:8, III:5, IV:3, V:0
C322	14	I:14, II:11, III:8, IV:4, V:0
C323	10	I:10, II:8, III:6, IV:3, V:0
C331	6	I:6, II:5, III:3, IV:1, V:0
C332	10	I:10, II:8, III:6, IV:3, V:0
C333	8	I:8, II:6, III:4, IV:2, V:0

Table 5 Indicator score of nine districts for sustainable value assessment

Criterion	Indicator	Allocation scores	Score of experts								
			①	②	③	④	⑤	⑥	⑦	⑧	⑨
B31	C311	10	10	10	9	10	10	10	10	9	8
	C312	19	17	18	19	17	18	19	19	15	10
	C313	12	10	12	12	12	12	12	12	7	7
B32	C321	11	9	11	11	11	11	11	10	7	3
	C322	14	12	14	14	9	10	8	14	10	11
	C323	10	7	8	9	9	7	10	9	7	5
B33	C331	6	4	5	6	4	5	7	5	3	2
	C332	10	7	10	6	8	7	10	9	7	8
	C333	8	6	7	8	8	8	8	8	5	5
			82	95	94	88	88	95	96	70	59

and aesthetic value. Among these three elements, aesthetic value occupies the highest weight through scoring. Among the nine historical and cultural blocks, the Yonghegong district scored the highest in aesthetic value. The results also show that the historical and cultural districts of cultural types have high aesthetic value, and score high in scarcity and integrity. Finally, the third point in the historical environment is the spatial environment, including building density, building floor area ratio and the height width ratio of main streets and lanes. Compared with cultural environment and historical environment, spatial environment is quantifiable. In the nine cases of this study, the highest building density is Beiluoguxiang in the residential historical and cultural districts. The highest building floor area ratio is Dongjiao Minxiang and Beiluoguxiang. It can also be seen from the score that the spatial environmental factors have little difference among the three types of historical districts.

Comparative analysis of use value

Table 7 shows the evaluation results of the use value of 9 historical and cultural districts. The results obtained from the data show that cultural and commercial historical and cultural districts have high use value. Among them, Shichahai and Dashilan historical and cultural blocks scored higher. Use value mainly refers to the efficiency and feeling of using the block. It includes three aspects: communication environment, business environment and living environment. Use value mainly refers to the efficiency and feeling of using the block. It includes three aspects: communication environment, business environment and living environment. The results show that the cultural and commercial historical blocks score higher in the communication environment. The communication environment includes three aspects: the continuity of public space, the greening rate and the utilization

rate of recreational facilities. The continuity of public space, in nine cases, scored equally. The greening rate of space and the utilization rate of leisure space are low in residential districts.

The results show that the commercial environment and residential environment in use value have higher scores in commercial and residential historical blocks respectively. The business environment includes business scale, business density and business type. This type of historical block is dominated by commercial activities with large scale, high density and rich types. The highest score is Nanluoguxiang. Cultural historical blocks also have high scores in the commercial environment, while residential historical blocks are closer to daily life in the commercial type. Finally, the three types of historical and cultural blocks have received the highest evaluation in terms of living environment. The measurement index of living environment is the content of serving the living space and living feeling, including neighborhood intimacy, living service facilities and sanitation facilities. These three indicators score equally in the three types of historical and cultural blocks. It can be seen that although the cultural and commercial historical and cultural blocks are not dominated by residential functions, they also have a better living environment. The vitality evaluation of use value shows that the three types of historical and cultural districts have high use value. This value, as a contemporary social resource, meets social needs.

Comparative analysis of sustainable value

The sustainable value of historical and cultural blocks is evaluated in three aspects: educational environment, attraction and creativity. These three indicators are unquantifiable social sustainable contribution. The specific way of expression is social participation. The three types of historical and cultural blocks are fairly evaluated

Table 7 Indicator score of nine districts for use value assessment

Criterion	Indicator	Allocation scores	Score of experts								
			①	②	③	④	⑤	⑥	⑦	⑧	⑨
B21	C211	15	14	13	15	15	15	14	13	10	12
	C212	12	8	10	12	10	7	4	12	7	5
	C213	10	7	10	6	5	10	7	5	4	5
B22	C221	12	7	10	8	10	11	12	2	5	6
	C222	6	2	3	4	4	6	5	1	1	1
	C223	8	2	6	4	5	6	4	1	1	1
B23	C231	8	7	5	3	2	2	3	5	7	8
	C232	17	15	13	12	12	13	12	12	14	15
	C233	12	11	12	12	12	11	12	11	12	11
			73	82	76	75	81	73	62	61	64

in these three indicators. Among them, the highest score of educational environment is Jingshan historical and cultural district, which is characterized by high public interaction, extensive cognitive groups and many important activities. The highest score of attraction index is Yonghegong and Jingshan historical and cultural district. Attraction refers to the attraction of core values, which is embodied in public participation, quality stability and heritage organization. In addition, the highest score of creativity index is the historical and cultural district of Nanluoguxiang, which has more academic achievements, more innovative service projects and value periodicity, that is, the stability of the overall image. Finally, the results show that in the evaluation of sustainable value, the three blocks with the highest vitality are Jingshan, Nanluoguxiang and Shichahai historical and cultural districts.

In summary, Yonghegong has the highest historical value. Shichahai has the highest use value. Shichahai and Nanluoguxiang have the highest sustainable value. The scores of these three blocks in the three values are basically the top three. It can be seen that the three values are inseparable. By calculation, the vitality of these three blocks is also the top three (Yonghegong 87.41, Shichahai 83.13, Nanluoguxiang 77.57). Therefore, the three aspects of value jointly affect the vitality of the districts. Streets with high vitality have high historical value, use value and sustainable value.

Discussion

This study evaluates and ranks the vitality of historical and cultural districts with the dimension of value and analytic hierarchy process. Combined with the scoring of experts, it also constructs a research framework for evaluating the vitality of historical and cultural districts from the perspective of value. The results show that at present, the blocks that mainly embody cultural values have higher vitality than those that mainly embody commercial values and residential values.

Compared with the current research on value evaluation and street vitality evaluation, our main contribution is to combine value and street vitality. This study evaluates street vitality from the dimension of value evaluation, and uses Cronbach's alpha to verify the reliability of the target for the current use of analytic hierarchy process in evaluation research. It fills the gap in the evaluation of historical and cultural districts from the value dimension. In the current research, analytic hierarchy process is used for decision-making [63] and evaluation [64] in the field of heritage protection. In this study, the method is optimized and ranked according to the scores of experts. More importantly, for the vitality evaluation

of historical and cultural blocks, this study constructs an evaluation model from three values. The purpose of evaluation is to find the weak points that affect the value, so as to improve the index. Value factor is the core resource of historical and cultural heritage. As for the three value categories of this study first of all historical value is the core of value. Although it is an unquantifiable factor it can be recognized and evaluated through historical environment cultural environment and spatial environment factors. Secondly the use value of historical and cultural blocks is the value generated by carrying social functions. For example historical and cultural blocks are used as educational cultural and tourist destinations. The third is sustainable value of historical and cultural blocks. Sustainability refers to a longer-term perspective to judge whether its utilization is in line with its historical value and can give full play to its advantages. Only through more flexible ways can it maintain its vitality for a long time. The way specifically refers to the participation and attention of the society and the public so that people cherish and respect cultural diversity. Therefore this study recognizes the vitality of historical and cultural blocks from the perspective of value which is of great importance to the contemporary development of historical and cultural blocks.

In the process of this study, we found some deficiencies worthy of further research: (1) the performance of the vitality of historical and cultural districts is dynamic, which is not only related to the dimension of value, but also related to people's activity time in the street. (2) We chose three types, a total of 9 historical and cultural districts. In fact, the number of historical and cultural blocks in the capital Beijing is large and different, so more cases are needed for comparative research and analysis. (3) For the choice of value elements, this is the most important factor for vitality evaluation. However, value cognition is a subjective concept, which expresses the cognition of a certain group. It is representative, but it does not represent all groups.

This study establishes a quantitative evaluation system of the vitality of historical blocks based on the value dimension. The framework can be used to collect expert opinions, conduct quantitative value evaluation, and adjust various indicators in practice before the protection strategy of historical and cultural blocks is proposed.

The vitality of historical and cultural blocks is obvious, and this research and method is only evaluated and verified from the perspective of experts. Therefore, in the future research, it is suggested to pay attention to different groups, such as tourists and residents in the historical and cultural blocks.

Conclusions

This study proposes a framework for evaluating the vitality of historical and cultural blocks with value as a dimension, and selects three different values, historical value, use value and sustainable value. In the case study, nine historical and cultural districts of three types are selected in Beijing, China. Comprehensive analysis and ranking are carried out by means of on-site investigation and expert scoring. The results show that Shichahai, Yonghegong and Liulichang blocks are the three historical and cultural districts with the highest vitality. Two of them are cultural blocks. In addition, different types of blocks are different in the ranking of different values. The three districts with the most significant historical value are cultural districts. The blocks with the most significant use value are cultural and commercial districts. Three districts with significant sustainable value appear in three types: Shichahai, Nanluoguxiang and Jingshan districts. Therefore, from the perspective of value dimension, the vitality of the block is not invariable. The study provides ideas for improving the vitality of different types of districts. On the other hand, the method, framework and results of this study provide enlightenment for sustainable development of the vitality in the future. Through this method, we can provide ideas for sustainable development of blocks and historical cities from three value dimensions.

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All the data generated or analyzed during this study are included in this published paper.

Declarations

Competing interests

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