

Progress in the Research of Urban Historic Built Environment Evaluation in China

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Abstract:

In this paper, a combination of quantitative and qualitative analysis methods was adopted to discuss the research progress, because it is particularly important to study and evaluate urban historic built environment with the deepening of urban renewal in China. Firstly, the bibliometric analysis was carried out to describe the current situation of the number of articles published each year, authors and research institutions, etc., and then the research hotspots were revealed, the subject contents were summarized, and the evolution law was sorted out, so as to provide a reference for building a scientific evaluation system. On this basis, the key areas for future research were proposed from the aspects of theoretical research, method research and practical research. The results show that in the future, an integrated research system should be built, and multi-disciplinary integration, multi-institutional communication, horizontal and vertical comparative studies on the evaluation of historic built environment, comparative studies of different evaluation subjects and analysis of the action mechanism after evaluation should be strengthened, so as to put forward practical and effective suggestions on the environmental protection of historic built cities in China.

Keywords: *Urban historic built environment, CiteSpace, Visualization, Evaluation.*

I. INTRODUCTION

In 2021, the "14th Five-Year Plan" explicitly proposed the implementation of urban renewal action, which indicates that China's urban built environment has entered a key stage of comprehensive transformation. In this context, it is particularly important to scientifically evaluate the heritage value, emotional cognition, social network and protection practice of the urban historic built environment. In a broad sense, the historic built environment refers to the remains of all human constructions and activities [1]. However, from the perspective of urban renewal, historic towns, blocks, sections and buildings have a direct and important influence on urban construction [2]. Therefore, the CNKI database was used to collate the literature of the above four types of historic built environmental assessment studies and to construct a knowledge map to show the development trend of such academic research in China. Next, the main contents were classified and commented to provide theoretical and methodological guidance for the exploration of evaluation system. In addition, the research hot spots, research topics and evolution rules in

this field were sorted out to provide innovation space for subsequent research.

II. DATA SOURCES AND METHODOLOGY

2.1 Data Sources

In order to ensure the integrity of the analysis samples, CNKI database with comprehensive Chinese literature was selected as the data source. In order to ensure the comprehensiveness of the analysis sample, the search was conducted on January 15, 2022 with "historic town", "historic block", "historic district", "historic building" and "evaluation" as the terms and "topic" as the search path. In order to ensure the correlation of the analyzed samples, 968 valid sample articles were obtained after screening the search results and removing the newspaper reports, results' introductions and irrelevant articles.

2.2 Methodology

In order to sort out the research progress of China's urban historic built environment assessment more systematically and intuitively, the advantages of quantitative analysis and qualitative analysis were combined. Specifically, 968 valid sample documents were imported into the software by using CiteSpace for data visualization analysis, with a time span of 2001-2021 and a time slice of 1 year. Scientific knowledge maps were obtained by means of data mining, information processing, visualization and so on, and content such as keyword co-occurrence and clustering were presented. Research hotspots, paths and trends were revealed by data node size and network connection strength, so as to avoid subjectivity in document sorting [3]. Qualitative analysis was used to analyze the main research contents and avoid one-sidedness of software analysis.

III. BILIOMETRIC ANALYSIS

3.1 Analysis on Number of Annually Published Papers

The quantity of literature reflects the degree of attention of academic research. The trend of the number of articles published in the year shows a trend of slow growth and then rapid growth, especially in the last decade, and the research attention continues to rise. A straight line ($y=6.4766x-25.148$) was obtained after the fitting analysis of the distribution index, and the fitting degree (R^2) reached 0.8775, indicating that the annual number of posts increased linearly. In addition, the number of articles published each year has obvious stages. The first stage is the embryonic stage from 1995 to 2004, during which the annual number of articles published is no more than 4. The research first appeared in 1995 when Wang Ziwen analyzed the streetscape of Beishan Road, West Lake, Hangzhou with the concepts of visual stride and view box, and put forward the characteristic evaluation method of historic streetscape [4]. In 2002, Zhu Guangya et al. put forward the architectural heritage evaluation system for the first time by using Delphi method and fuzzy comprehensive evaluation method to systematically evaluate the value of four architectural heritages in Yongjia County, Zhejiang Province [5]. The second stage is the exploration period from 2005 to 2010,

during which the number of articles published increased significantly compared with the first stage. In 2005, the *Regulations for the Protection and Planning of Historical and Cultural Cities* stipulated in detail the protection boundaries, renovation methods, municipal works and road traffic of historical and cultural cities, historical and cultural blocks, cultural relics protection units and historical buildings, marking the beginning of a legal basis for the protection of the historic built environment. During this period, the overall research was strengthened in depth and breadth from multiple perspectives. The third stage is the outbreak period since 2011, during which the number of posts increased significantly. The annual number of posts was several times higher than that of the second stage, and reached its peak in 2019. In 2011, the United Nations Educational, Scientific and Cultural Organization (UNESCO) proposed to protect the long-standing urban historical environment from the deterioration and division caused by rapid urban development. Following a series of policies, this field gradually became a new academic hotspot. With the multi-disciplinary intervention, the research perspectives are more diversified, such as space, landscape, emotion, satisfaction and sustainability. China entered an important stage of urban renewal in 2021, which indicates that the research on the evaluation of urban built environment in China's history will continue to become a hot research field in the future, and may promote a new growth trend in the number of articles published after 2021 (Fig. 1).

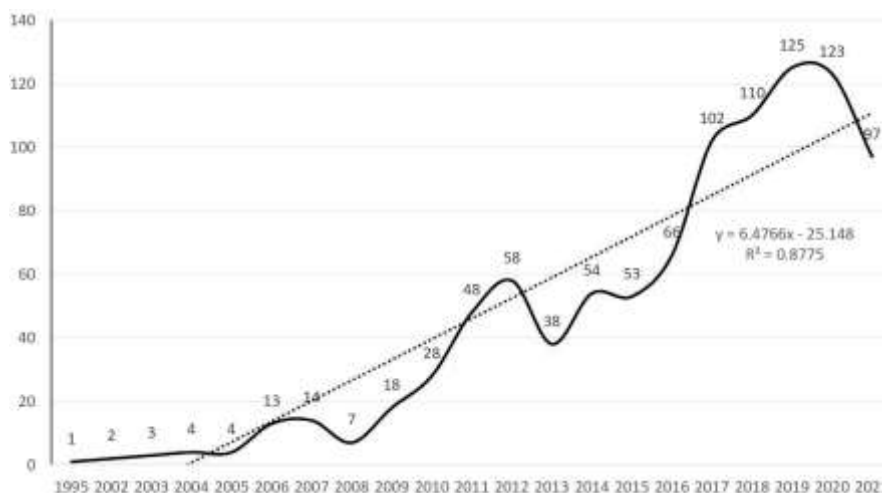


Fig. 1: Statistics of number of published papers from 1995 to 2021

3.2 Analysis on Research Authors

3.2.1 Authors and the number of their published papers

According to the histogram of authors and their published papers (Fig. 2), 9 authors have published more than 3 papers, and 21 authors have published 3. The data show that most of the authors publish their papers for the first time, and the overall maturity is low. Among them, Li Heping has the largest number of related papers published and the greatest influence. In 2002, Li Heping studied the built environment of Old Town of Lijiang, analyzed its spatial layout and the characteristics of traditional dwellings, excavated its heritage value, and put forward the protection mechanism of the ancient city [6]. After that, he did a lot

of research on the historic built environment, including protection and renewal, evolution law, value evaluation and so on. The article with the highest citation and the highest download volume was *Research on Value Evaluation and Protection and Utilization Gradient of Chongqing Industrial Heritage*. The analytical methods he used included qualitative weight allocation and quantitative evaluation indexes, construction of value evaluation system, determination of protection level and proposal of diversified protection modes, which provided reference for subsequent research [7].

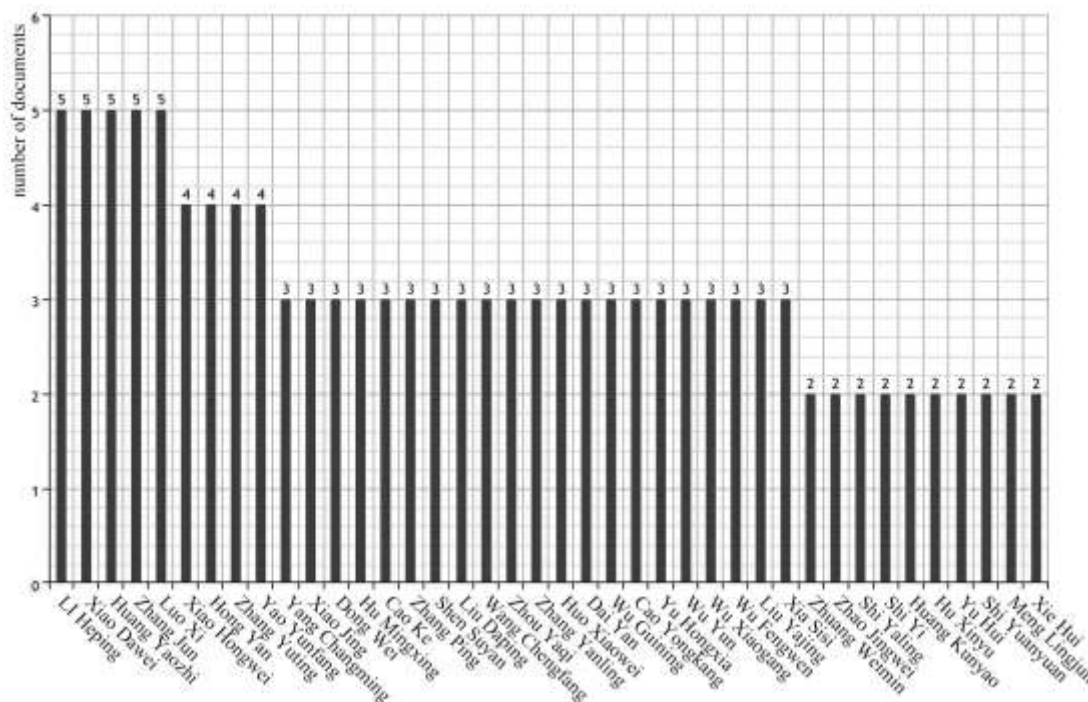


Fig. 2: The histogram of authors and their published papers

3.2.2 Cooperation network of authors

From the diagram of the author's cooperation network (Fig. 3), some stable cooperation groups have been formed in the study of urban built environment evaluation in China, such as the teams of Li Heping, Xiao Hongwei and Guo Xuan, et al. of Chongqing University, Lin Huiqing, Ke Ting and Chen Meirong, et al. of Fuzhou University, Zhang Jun and Liu Daping, et al. of Harbin Institute of Technology, etc. Cooperation is characterized by "team gathering and overall dispersion". Most teams conduct research with scholars in regions or universities as groups, and they are closely connected within the teams, but not among teams. Different research teams have certain differences in research content, which results in less cooperation. The darker the links between authors are, the closer the cooperation is. Li Heping has the closest team cooperation and the largest number of papers.



Fig. 3: Cooperation network of authors

3.3 Analysis on Research Organizations

3.3.1 Organizations and the number of their published papers

From the histogram of organizations and the number of their published papers (Fig. 4), the organizations with the top 40 number of published papers are all universities, indicating that universities play a leading role in the research of this academic field. The top 5 institutions with more than 60 articles were Xi'an University of Architecture and Technology, Chongqing University, South China University of Technology, Tianjin University and Southeast University in descending order from high to low number of published papers. The number of papers published by Xi'an University of Architecture and Technology reached 110, far exceeding that of other universities. Therefore, Xi 'an, as one of the four ancient capitals in the world, is rich in architectural heritage, which highlights its geographical advantages in this field.

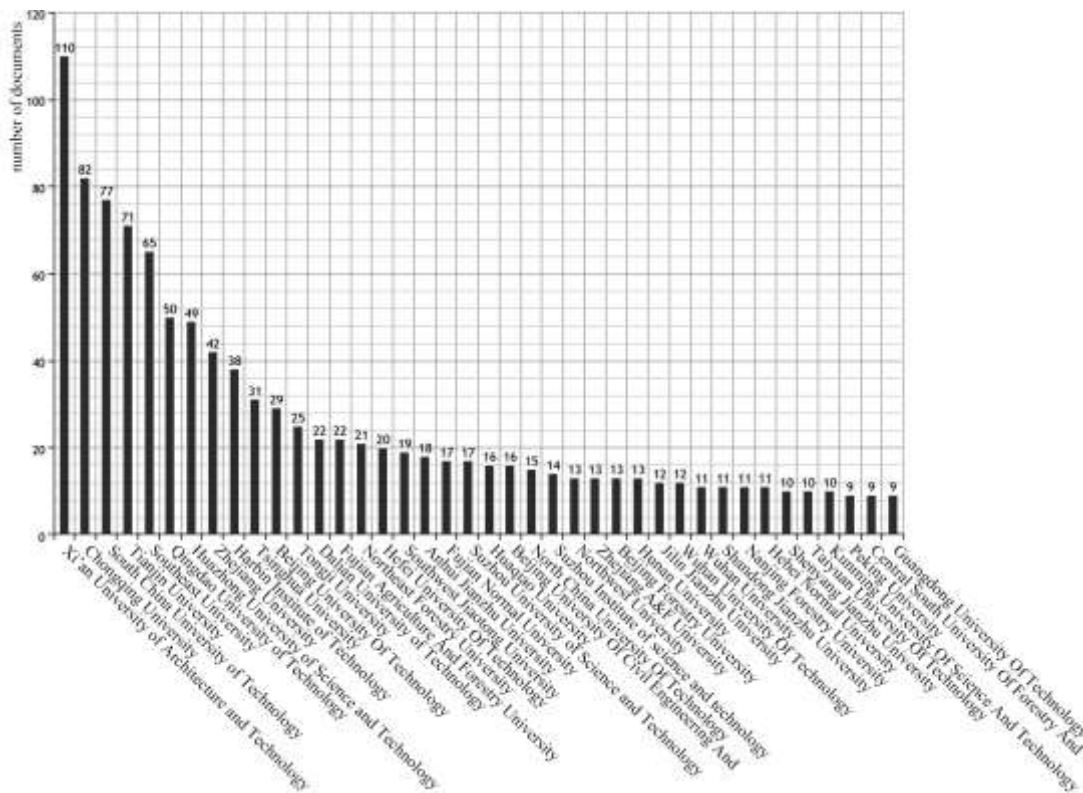


Fig. 4: Histogram of organizations and the number of their published papers

3.3.2 Cooperation network of organizations

It is concluded from the cooperation network diagram of organizations (Fig. 5) that there is no connection between nodes in the diagram, which indicates that research is conducted on the basis of organizations themselves at this stage, and no cooperation network has been established among organizations to exchange information and learn from each other, which affects the further development of research to some extent. In the future, academic exchanges and cooperation in the study of historic built environment evaluation need to be strengthened.

classified into 4 most important topics, including the protection and promotion of the physical environment, the cognition and development of emotional images, the change and inheritance of social characteristics and the organization and construction of crowd activities.

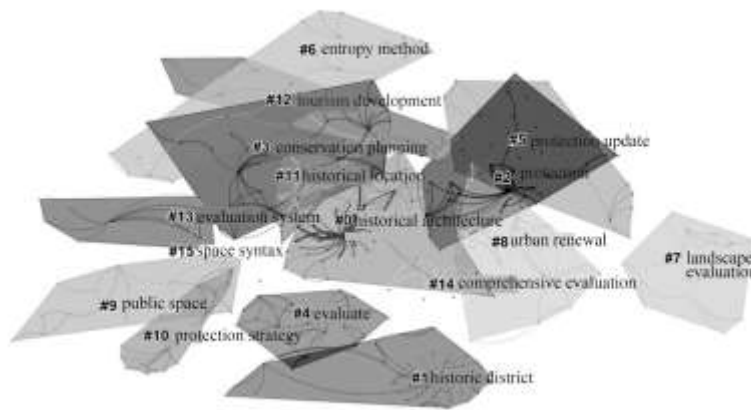


Fig. 6: Hierarchical diagram of keywords

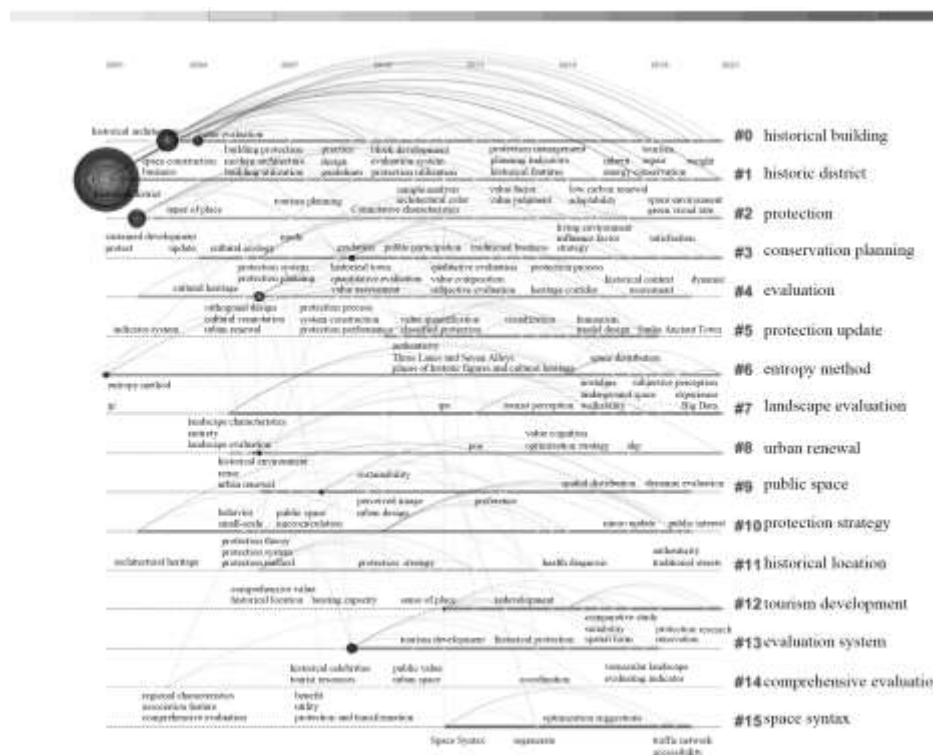
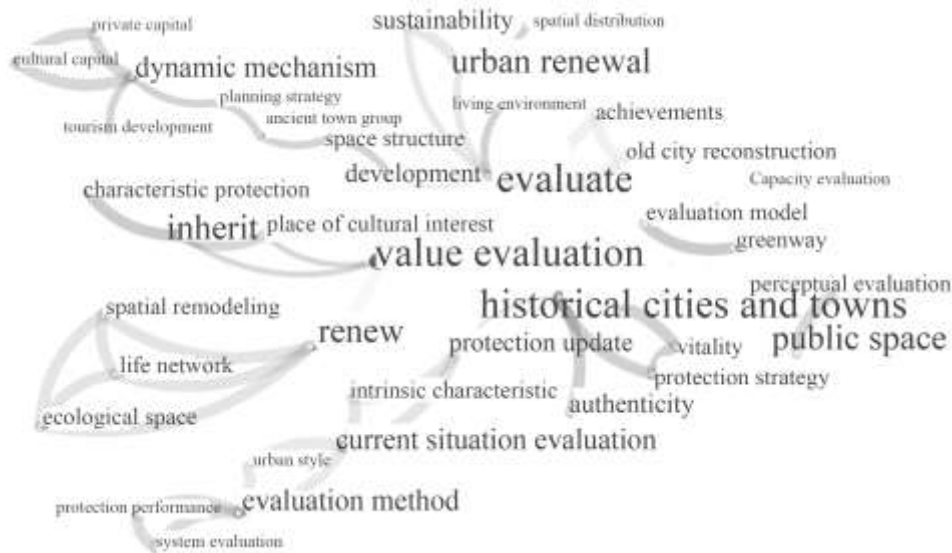


Fig. 7: Timeline mapping

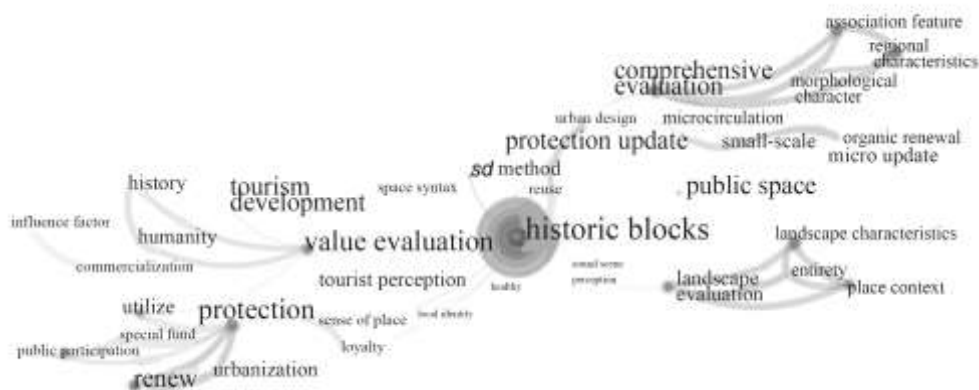
4.3 Analysis on Research Paths

The relationship between keywords can reveal the research path. The co-occurrence analysis was performed on the four types of historic built environments to generate the keyword co-occurrence map 2015

(Fig. 8). Through the analysis on the size of each node and path branches, the research path for the evaluation of urban historic built environment in China was sorted out (Table I), which exhibited the development context and basic characteristics of this academic field and provided reference for subsequent research.



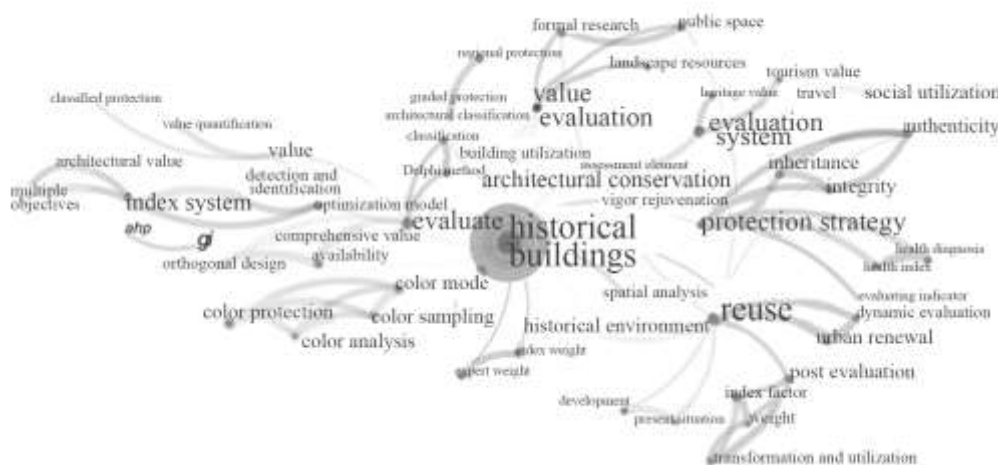
a. Co-occurrence mapping of keywords for the research of historical cities and towns evaluation



b. Co-occurrence mapping of keywords for the research of historical blocks



c. Co-occurrence mapping of keywords for the research of historic sites



d. Co-occurrence mapping of keywords for the research of historical buildings

Fig. 8: Co-occurrence mapping of keywords for the research of urban historic built environments

TABLE I. Research paths of urban historic built environment evaluation

direction	research path of historical towns	research path of historical block
1	historical town-protection update-current situation evaluation-evaluation method-evaluation system	historic block-comprehensive evaluation-association feature-morphological feature-regional feature
2	historical town-public space-perceptual evaluation-capacity evaluation-road evaluation	historic block-landscape evaluation-landscape characteristics-sound scene perception-context of place
3	urban renewal-old city reconstruction-living environment-sustainability-evaluation model	historic block-value evaluation-tourism development-historical humanities-influence factor
4	value evaluation-development and inheritance-space structure-dynamic mechanism-tourism development	protection update-urbanization-small-scale-micro update-microcirculation-reuse
direction	research path of historic sites	research path of historic buildings

1	historic sites-scope of protection-index system-influence factor-sustainability	historic buildings-comprehensive evaluation-mathematical model-index system-classified protection
2	historic sites-protection update-context inheritance-tourist resources-coordinated development	historic buildings-value evaluation-spatial analysis-formal research-tourism development
3	historic sites-comprehensive value-quantitative evaluation-qualitative evaluation-evaluation system	historic buildings-color protection-color sampling-color analysis-color mode
4	historic sites-place space-regeneration evaluation-mechanism-protection transformation	historic buildings-reuse-integrity-authenticity-post evaluation-inheritance
feature	Same: They are all based on the protection, transformation and evaluation of tourism development; Both pay attention to comprehensive evaluation and value evaluation; The construction process of the evaluation system is the same. Differences: Different research objects pay different attention due to different scope. The urban scale is biased towards the evaluation of space and capacity; The block scale is biased towards the evaluation of shape and landscape; The section scale is biased towards the evaluation of space and place; The architectural scale is biased towards the evaluation of form and color.	

V. ANALYSIS ON RESEARCH CONTENTS

CiteSpace can be used to get intuitive and visual results, but it lacks in-depth analysis of research content, which needs to be further summarized and discussed. With a series of changes in the concept of heritage protection from monomer construction to the overall environment, from material space to humanistic spirit, from enclosure preservation to activation and use, from government decision-making to public participation, the research content of urban historic built environment assessment has been continuously expanded and deepened, which is mainly implied in the topics of material environment protection and promotion, emotional image cognition and development, social characteristics change and inheritance, and crowd activity organization and construction [9].

5.1 Physical Environment Protection and Promotion

Material environment, as an important factor in the built environment of urban history, is the carrier of emotion, society and all activities, including spatial form and natural environment. The evaluation of material environment mainly focuses on three aspects: public spatial form, underground space resources and landscape audio-visual perception. The physical environment is perceived by the user, with visual perception as the main, and auditory perception is second only to visual perception.

5.1.1 Public spatial form

Most of the public spaces in the built environment are street spaces, which are important places for daily communication. Shi Ruoming et al. used GIS and fuzzy mathematics to evaluate the present situation of historical blocks by combining the data characteristics of spatial location, and solved the difficult unification of qualitative and quantitative indicators [10]. Zhou Mengru et al. proposed an evaluation system for the pedestrian environment in the historical and cultural blocks based on identifiability, flatness, pedestrian density, smoothness, effective width and shading rate for the street space in Shichahai block in Beijing, and divided the streets into seven categories and implemented classified improvement strategies [11]. Liang Chen et al. studied the optimization of pedestrian environment in the historical and cultural

blocks of the five major road district of Tianjin, and built an evaluation system of pedestrian environment from four aspects: space environment, psychological perception, hardware facilities and street system, and then analyzed the data by IPA analysis method to formulate optimization strategies [12].

5.1.2 Underground space resources

Evaluation of underground space resources is an effective way to solve the contradiction between development and protection of underground space resources in nearby areas. Zhao Xudong et al. analyzed the influencing factors of the quality of underground space resources in Yangzhou Dongguan Historic District and adopted multi-level and weighted average fuzzy mathematics comprehensive evaluation method to construct an evaluation model [13]. In addition, Zhu Yinge et al. believed that historical blocks are carriers of humanistic spirit and also are living areas, so they built an evaluation model of underground space value by combining residents' living needs with previous evaluation indicators [14]. By contrast, although the evaluation model constructed by Zhao Xudong et al. is more systematic and perfect, it ignores the elements of life needs mentioned by Zhu Yinge et al.

5.1.3 Landscape audio-visual perception

The evaluation of landscape audio-visual perception is of great significance in shaping regional cultural personality and cultivating local identity. Luo Xi et al. constructed a visual landscape evaluation system from the perspective of vision by using the method of landscape pictures and combining the characteristics of historical and cultural blocks, proposed the evaluation steps, and formulated the pollution evaluation standard [15]. Zhang Jun studied the evaluation of the spatial elements of typical historical blocks along the Middle East railway with the Bag of Visual Word from the perspective of computer vision classification, and quantified the characteristics of the blocks [16]. Deng Zhiyong et al. evaluated the soundscape of six historical blocks in China by SD method from the auditory point of view, compared the feelings of students and residents, quantitatively analyzed the relationship between acoustic parameters and semantic evaluation, and concluded that students' expectations should be paid attention to and the semantic environment such as soundscape coordinates and tone of voice concerned by residents should be protected [17]. Since visual perception will be different due to viewing angles, it is more scientific to use landscape pictures to evaluate from specific viewing angles. Besides, the introduction of the Bag of Visual Word can make the evaluation criteria clearer. In view of the complexity of audio-visual perception, the conclusion should be tested for universality through horizontal comparison in several regions.

5.2 Cognition and Development of Emotional Imagery

Emotional imagery refers to spiritual experience, including authenticity, sense of place and city memory. Authenticity not only includes whether the place continues the traditional style and features, but also includes residents and tourists' perception of local authenticity [18]. The sense of place is the feeling acquired by human consciousness and action in the process of participation, which is related to historical culture, geographical characteristics and urban memory. Each city has its own unique memory, which is inherited by the tangible and intangible heritage of the city.

5.2.1 Authenticity

As the unity of material and spirit, authenticity needs to keep the traditional style and lifestyle and continue the humanistic spirit, which is the result of constantly adapting to modern life and re-creation [19]. Liao Renjing et al. integrated the domestic and foreign scholars' research on authenticity, and based on this, divided the survey subjects into foreign tourists, temporary residents and local residents, and analyzed and summarized the two factors of constructing authenticity using exploratory factor analysis, and compared the perception differences of different types of survey subjects [18]. Zheng Ying et al. evaluated the authenticity and integrity of historical blocks on the basis of road network (the research sample was a former Japanese concession in Tianjin), and compared the original appearance and present situation from the width, length and name of roads, and concluded that the important factor affecting the landscape of historical blocks is the width of sidewalks [20]. Ding Shaoping et al. used quantitative analysis and perceptual experience as evaluation strategies to evaluate the authenticity of the style and pattern of five historical blocks, and proposed updating measures based on the comparison of field feelings [21]. With the development of time, the factors that did not reflect authenticity may gradually be accepted by people, so the discussion on authenticity needs to be continuously studied and updated in time.

5.2.2 Sense of place

The sense of place is the core concept of spatial phenomenology, which is also translated as the location sense. On the basis of summarizing the cognitive process and influencing factors of sense of place, Wang Fang et al. put forward the elements of sense of place, constructed an evaluation system composed of tourist background, tourist destination background and sense of place content after screening, and made Pearson correlation analysis on the questionnaire, so as to clarify the law of tourists' sense of place cognition [22]. Xiang Lanlin et al. used grounded theory to conduct an investigation and interview in South Luogu Lane, Beijing, and extracted 29 local cognitive factors to construct an evaluation system of local sensation, and compared the local sensation of local residents, merchants and tourists [23]. The research on the sense of place focuses on tourism, and the main contradictions are the concept discrimination, dimension division, and evaluation subject differences. That is to say, there is no consensus on the constituent elements of the sense of place, but differences in the perceptions of different evaluation subjects, which need to be further explored in practice.

5.2.3 City memory

The urban historic built environment bears the memories of the past and the present of the city, which are the important source of the formation of urban characteristics [24]. Wang Fang et al. obtained the cognition variables of tourists to urban memory in South Luogu Lane, Beijing through questionnaires, constructed the measurement index system of urban memory cognition and the formula of urban memory cognition degree, and summarized the cognition rules of tourists [24]. Wen Tong et al. studied the influence of urban space on city memory (the research object was the consumption group of Lingnan Tiandi in Foshan), and conducted evaluation and analysis from the perspective of supply and demand

relationship, so as to construct the operation mechanism of urban memory continuation [25]. It is the focus of future research to compare the cognition of city memory with that of residents and tourists.

5.3 Changes and Inheritance of Social Characteristics

In addition to the material environment and emotional imagery, the urban historic built environment is also closely related to social development and influenced by national policies and protection theories, including social network relations, creation of neighborhood vitality, sustainable development and heritage value evaluation.

5.3.1 Social network relations

Compared with space syntax, Social Network Analysis (SNA) is good at quantitative research on internal relations to express the overall and individual characteristics of social networks. Huang Yong and Shi Yaling studied the related problems of social network structure in historical towns, built an evaluation model by social network analysis with the help of Ucinet6.0 platform, and put forward protection measures from two aspects of material form and social network [26]. Huang Jianwen et al. studied the matching of residents' activity path network and public space network in Changdi Historic District, and evaluated the effectiveness of block micro-renewal through complex network theory, and concluded that both of them were partially out of touch and partially matched [27]. In the follow-up, the research on the integrity of the social network relationship needs to be strengthened, and the comparative research on the social relationship due to the time change should be paid attention to.

5.3.2 Creation of neighborhood vitality

Enhancing vitality is an important means to revive the urban historic built environment. Han Le et al. constructed an evaluation system of the public space vitality of historical blocks with five indicators including interactive service facilities, open space, parking facilities, recreational facilities and accessible greening using Delphi method and analytic hierarchy process, and conducted an empirical study [28]. Long Ying et al. constructed the quantitative evaluation system of street vitality based on street urbanism and a case study of well-known streets in Chengdu and quantified the index using GIS, and concluded that the factors affecting the street vitality varied greatly due to different types [29]. Zhang Song et al. combed the related theories of urban spatial vitality and the relationship between historic built environment and vitality, and constructed an evaluation model of urban historic built environment vitality from social, economic and cultural aspects [30]. It is helpful to improve the vitality of the city to evaluate the vitality of the historic built environment in the era of stock development.

5.3.3 Sustainable development

The goal of sustainable development is to improve the overall appearance and vitality of the city by transforming the old areas based on the heritage of humanistic spirit and the protection of traditional style.

Lyu Bin et al. constructed a social evaluation system for the sustainable regeneration planning performance of historical blocks from the perspective of sustainability, which included five indicators such as satisfaction, recognition, and influence, thus providing reference for urban design by evaluating different types of people [31]. Xiong Zhongyang et al. studied the related issues of the sustainable development of historical blocks in Jiang'an District, Wuhan, and built a sustainable renewal evaluation system according to DPSIR (Driving Force-Pressure-State-Impact- Response) framework [32]. Li Jianhua et al. constructed the health evaluation system of historical blocks from six aspects, such as health industry, layout, culture, transportation, management and environment from the perspective of protection and development, so as to explore a healthy development model [33]. The evaluation research provides an important reference for sustainable development.

5.3.4 Heritage value evaluation

How to evaluate the value of historic built environment in urban renewal has become the focus of attention of urban planners, enterprises and the public. Yan Yiran et al. integrated the related research on the value evaluation of traditional scenic spots, studied the evaluation indicators based on typology, and built a value evaluation system on this basis, including three elements: history and culture, architecture and place, pattern and landscape, and finally proposed planning strategies for different conservation and renewal tendencies [34]. Zheng Xiaohua et al. established the value evaluation system of historical buildings with the help of GIS technology, divided the buildings into four types, and proposed different planning measures [35]. Tai Huixin et al. constructed the value evaluation system of historical buildings including scientific value, practical value, and historical value, endowed the experts with preference for extremes with small weights, and improved the weight calculation of Delphi method to make it more scientific [36]. The value evaluation system can determine the repair methods of the historic built environment, such as retention, repair, and so on. The graded protection is an effective measure to coordinate the social and economic development and the historic built environment.

5.4 Organization and Construction of Crowd Activities

People are the users of human space and the most valuable research subjects. Crowd activities, as an important factor of urban historical built environment, are of great significance for its organization and construction. Research on crowd activities includes user needs, satisfaction evaluation and business travel development.

5.4.1 User needs

The needs of various social groups are the key to evaluate the historic built environment [37]. Zhang Jun et al. used SD method to evaluate the transformation of historical blocks based on demand motivation theory and individual difference theory, and concluded that tourists tend to have emotional needs, while residents tend to have material needs [38]. Liu Tianqi et al. investigated to get the information about the needs of the elderly for the renewal of historical blocks, and constructed an evaluation system based on the

fuzzy comprehensive evaluation method, and obtained the strategies for the renewal of the elderly's living environment [39], in order to analyze the differences of different groups through understanding the needs of each group, and timely adjust and improve the protection measures.

5.4.2 Satisfaction evaluation

Through the satisfaction evaluation, targeted improvement measures can be put forward for the historic built environment. Zhu Hong et al. constructed the evaluation system of customer satisfaction of historical blocks with reference to ACSI model, and made an empirical study on Zhuangyuanfang in Guangzhou with Likert Scale [40]. Hu Yang et al. evaluated the historic district after the implementation of the plan from the public perspective with the built environment quality as the breakthrough point, and concluded that the key factors affecting the satisfaction degree include development mode, sanitary condition, handicrafts and traditional catering [41]. Wang Zhaoyu et al. evaluated the satisfaction degree of the historic district after renewal with SD method (the research sample was from online review text), and got the evaluation result through Python processing, which provided reference for spatial renewal planning [42]. It is the future research direction to explore the differences and connections of different groups' satisfaction.

5.4.3 Business travel development

In the context of cultural prosperity and tourism development, improving the quality of human settlement environment through business and tourism development has been the main way of environmental protection and development in history. Chen Meng et al. evaluated the commercialization of three historic districts in Ningbo, analyzed the performance and motivation of commercialization transformation, and aimed to provide reference for the transformation of historic districts [43]. Shen Suyan et al. studied the related issues of tourism development suitability evaluation of historical blocks, and constructed the corresponding evaluation system, with indicators including supporting facilities, quality of tourism resources, development potential and social and ecological environment [44]. Zhang Zhang et al. studied the impact of micro-built environment of historical streets on tourists' behavior of walking and parking, and constructed an evaluation system of micro-built environment elements, and used real-time image tracking to track the interaction between behavior and environment, in order to explore the impact mechanism [45].

VI. ANALYSIS ON EVOLUTION RULE

Evolution law can help to grasp the research trend and provide direction for future research. The time zone map (Fig. 9) represents the evolution of the study in the time dimension, reflects the development trajectory, duration and distribution characteristics of different stages, and shows the evolution of the study over time. The keyword burst map (Fig. 10) shows the change of keywords with time to analyze the research trend. Based on this, the study on the environmental assessment of urban historic buildings in China can be divided into three periods: the first period is from 2001 to 2004, during which the relevant

literature is less, focusing on heritage protection and comprehensive assessment, mainly analyzing the regional characteristics, correlation characteristics and morphological characteristics of historical blocks and historical buildings. The second stage is from 2005 to 2010, during which the research directions are gradually diversified, such as value evaluation, landscape evaluation, site context and quantitative evaluation, etc., and the research objects are further expanded to evaluate historical sites. The third stage is from 2011 to 2021, during which research began to pay attention to the relationship between environment and people, and a large number of post occupancy evaluation (POE) studies appeared. In 2011, the evaluation was made from the perspective of sense of place and authenticity, and in 2012, the evaluation was made from the perspective of tourism development. After that, the research focus turned to tourism development, and began to evaluate tourists' perception, tourism format and spatial distribution, mainly involving urban and rural planning, architecture, tourism, etc., as well as economics, geography, surveying and mapping, meteorology and other disciplines, which really became a multi-disciplinary project.

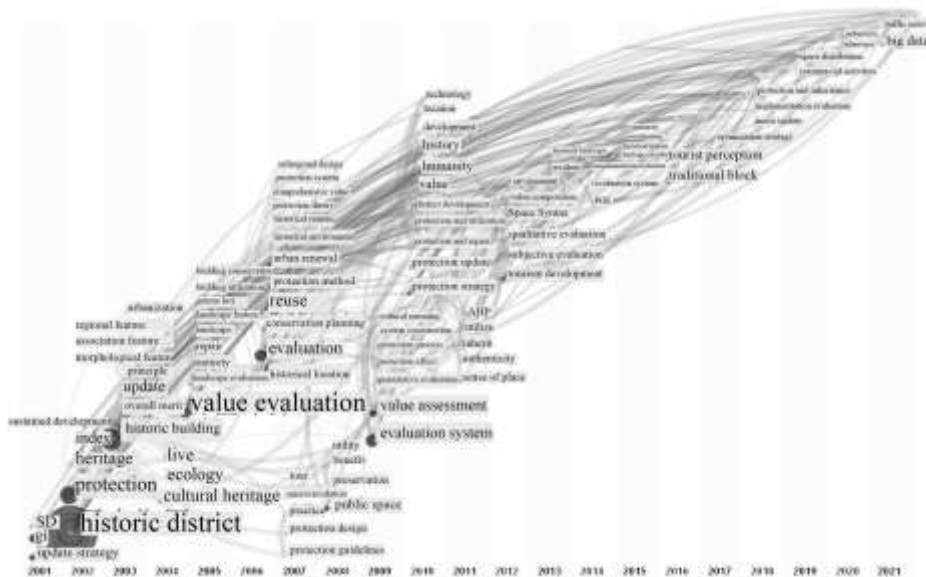


Fig. 9: Time zone map

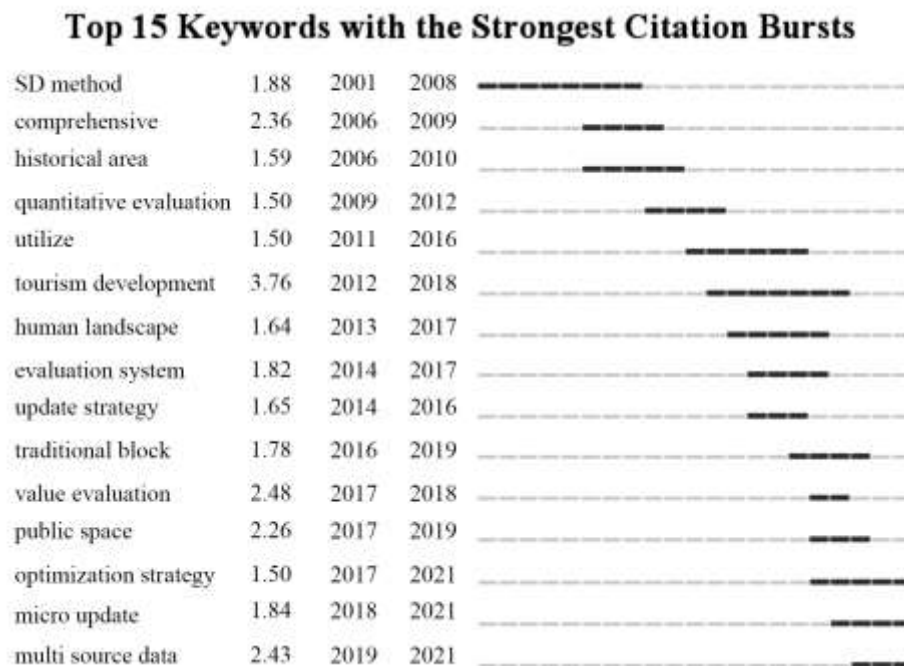


Fig. 10: Keyword burst map

VII. CONCLUSIONS AND DISCUSSIONS

7.1 Conclusions

(1) The research theory needs to be improved. For many years, the research theories of architecture, geography and tourism are mostly the introduction and discrimination of foreign concepts, without much breakthrough. Most of the evaluation methods used were modification and application of foreign systems and scales, and there were more repetitions in conclusions. Most studies focus on the strategies after evaluation, but pay little attention to the deep-seated mechanism. China's urban historic built environment is influenced by both external factors (national policies, social economy, etc.) and internal factors (personnel organization, social relations, etc.), with different modes of action. Therefore, it is necessary to construct an evaluation system from different perspectives to explore the underlying mechanism in order to improve the research theory.

(2) Method innovation needs to be strengthened. Despite the gradual expansion of research groups, the pattern with architecture, geography and tourism as its core has not changed. Therefore, multi-disciplinary cooperation in architecture, psychology, geography and sociology should be strengthened to give full play to their respective advantages. The research is gradually changing from qualitative evaluation to quantitative evaluation. The qualitative evaluation is mainly carried out by using Delphi method, literature review and other methods, while the quantitative evaluation is mainly carried out by mathematical model, computer-aided and other methods. Both qualitative and quantitative evaluation have their own advantages and limitations, so the combination of qualitative and quantitative evaluation methods will become the

trend of future research.

(3) Practical research needs to be expanded. In the past, most of the studies focused on single cases, but few of them were horizontal comparative evaluation of cases of the same geographical type or the same functional orientation and vertical comparative evaluation of cases of different time nodes. Moreover, the selection of some cases is typical, and whether the evaluation system and conclusion constructed are applicable to other areas needs to be confirmed in follow-up research.

7.2 Discussions

At present, China is at an important stage of urban renewal, during which the historic built environment of the city is protected and developed in many aspects, such as material environment, emotional image, social characteristics and crowd activities, so it is of great significance to evaluate it. On the basis of the previous studies, the future study on the urban historic built environmental assessment in China should strengthen the framework improvement, practical research and method innovation in the macro context of heritage protection and urban renewal combining with multi-disciplines such as architecture, psychology, geography and sociology. At the same time, attention should also be paid to the related research progress in foreign countries, which pay attention to the evaluation of sustainability, such as social sustainability [46], energy sustainability [47] and architectural sustainability [48]. Landorf explored social sustainability and its application in the historic built environment, and proposed a method to evaluate social sustainability in the historic built environment [46]. Egusquiza et al. introduced the method of evaluating the energy efficiency of historic districts, and formulated the evaluation system and multi-scale data model, which contributed to the energy conservation of historic districts [47]. Taherkhani et al. discussed the sustainable development and elastic development factors of historical residential buildings through Delphi method and analytic hierarchy process, and constructed a sustainability evaluation system to achieve the sustainable and elastic development goal of historical blocks [48]. Some scholars evaluate the adaptability and competitiveness of historical blocks to solve the problem of value and reuse of historical blocks [49-50]. Ramos et al. evaluated the economic, social and cultural impacts of tourism on the historic district of Battle Harbor in Labrador, and concluded that tourism can have a positive impact on the protection of local history and culture [51]. Moazen made use of the tourism industry to protect the traditional life of the historical blocks and proposed that one of the important ways to revive the historical blocks is to make use of the abandoned houses in the historical blocks [52]. In addition, some scholars also explored how to improve the quality of built environment and protect the sense of place from the perspective of cultural memory and place spirit [53-55]. The domestic and foreign research results provide reference for the study of urban historic built environment evaluation in China, and need to be further improved in the following aspects:

(1) Theoretical research on the evaluation of urban historic built environment. Generally speaking, the research has made great progress, but it is urgent to build a complete research framework because of more case studies and insufficient research. Due to the complex region and diverse cultures in China, it is necessary to deeply analyze the historic built environment, identify the types empirically and

quantitatively. In the meantime, the driving mechanisms of external forces and internal systems are also different. Based on this, a research framework with research theories, ideas, contents and methods is constructed to further promote the integrated development of research (Fig. 11).

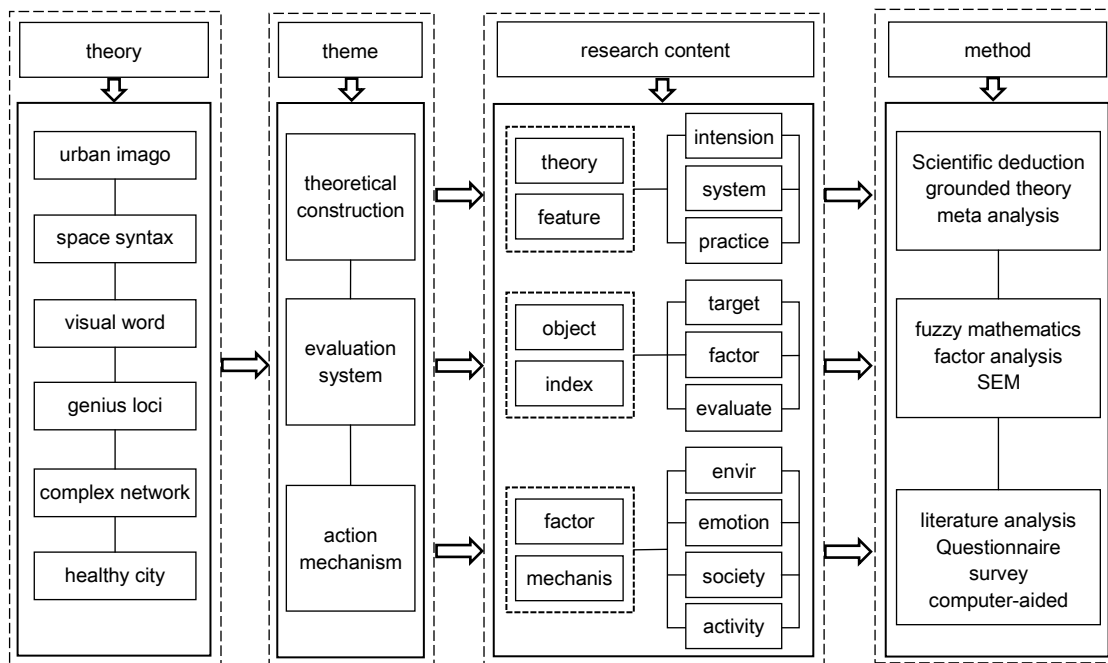


Fig. 11: The research framework of urban historic built environment evaluation

(2) Research on the method of urban historic built environment evaluation. As the evaluation of urban historic built environment involves the materialized spatial process, emotional spiritual experience, complicated social network and diversified crowd activities, it needs the interdisciplinary integration and the integrated research on various research methods, thus improving the depth and breadth of the research. The research focuses on 1) exploring the sense of place in the evaluation of human-land relationship and constructing quantifiable operational means by using the place theory, 2) deeply studying the quantitative visual evaluation system by using the bag-of-visual-words, landscape pictures and other theories, 3) studying the differences of satisfaction evaluation of different groups from the perspective of business openness, 4) constructing the energy evaluation system from the perspective of sustainability, and 5) studying the relationship between evaluation indexes that have mutual influence. In addition, the number of evaluation indicators should be appropriate, because too few indicators are not enough to reflect the integrity, while too many indicators are prone to overlap.

(3) Practical research on the evaluation of urban historic built environment. The urban historic built environment in China has spatial differences in different regions and cultural differences in the same region, which requires a large number of practical exploration. The research emphasis should be placed on the horizontal and vertical comparative study of the historic built environment to verify the universality of the conclusion, the evaluation study before and after the transformation to realize the protection of the urban historic built environment with the most appropriate development mode, and the analysis on the mechanism analysis behind the evaluation results of different historical built environments to further promote to an instructive theory.

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