

Research on the Development Trend of Urban Waterfront Space Design from The Perspective of Citespace

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Abstract: As a unique regional unit, the vitality of its waterfront space drives urban development to a certain extent. Focusing on the design and construction of urban waterfront spaces at home and abroad, CiteSpace software was used to quantitatively analyze to extract basic information such as regional time zones and hot keywords, construct a co-emergence map of hot research fields, analyze the development pulse of urban waterfront spaces, and elaborate possible future research directions, and strive to provide academic support for future research on the design of waterfront spaces along the waterfront in Macao and the same area. The analysis shows that a research system with urban waterfront space as the theme has been formed, and the research scope is subdivided into conceptual planning, mountain cities, urban renewal, urban double repair, urban vitality, etc., but the research and development in the system are uneven, and the research field continues to expand, and the research around urban double repair and urban vitality will continue to heat up and become the main research direction in the future.

Keywords: Urban waterfront space, Hot spot portrait, CiteSpace, Map analysis.

1. Introduction

John S. O. Symonds says in Landscape Architecture that "water is an irresistible attraction to all people, and to a certain extent, we seem to have the same instinct as our ancestors--- impatiently and unconsciously towards the water's edge." (John S. O. Simmonds, 2000 (John A. O. Simmonds, 2000) Many of the world's cities tend to be located at the intersection of rivers, lakes, seas, and land and sea, with one-third of the population concentrated in waterfront areas. To a certain extent, the development of waterfront space plays a huge role in driving urban development and urban vitality.

With the process of urbanization around the world, all countries are facing the problem of various "urban diseases", and with them the urban environment.

Cities also need to make changes to address the problems of water pollution, ecological and natural destruction, abandonment of waterfront gray space, imbalance of urban environment, and loss of vitality of urban external space. Compared with other urban elements, waterfront space plays a very positive role in solving the lack of land area of urban space and improving the quality of urban environment. At present, the vitality of urban open space is stimulated, and a large number of studies are actively carried out on the planning and sorting of waterfront open space. In the face of such a large and complex research result, it is necessary to use modern scientific quantitative tools to conduct a detailed analysis of the existing literature.

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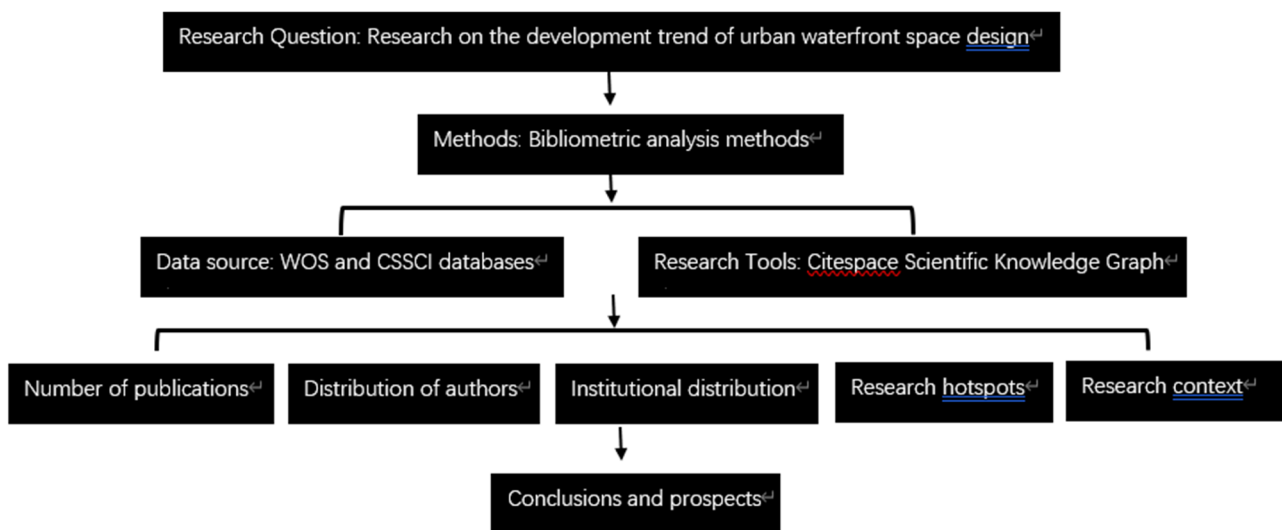


Figure 1. Dissertation research framework

2. Research Methods and Data Sources

2.1. Research methods

Bibliometric analysis objectively and systematically analyzes the changes and characteristics of the development process of academic research. Different from the traditional literature review method of reading and summarizing articles, there are problems of cumbersome one-sidedness and subjectivity. The scientific knowledge map is an image that takes the knowledge domain as the object and displays the development process and structural relationship of scientific knowledge. (Chen Yue, Chen Chaomei, Liu Zeyuan, et al., 2015) At present, most domestic scholars have conducted research on the use of citespace data visualization tools. For example, Wang Jue et al. (Wang Jue, 2022) have analyzed the field of marine spatial planning and studied land and sea coordination and sustainable development as well as Make recommendations on key areas for further exploration in the future.

CiteSpace is a visual analysis tool for scientific knowledge graphs, which can display key documents, hot research, preface directions, etc. in a certain scientific academic field. The collected literature titles, author information, year of publication, journals, and data from domestic and foreign research institutions will be statistically analyzed to analyze the time distribution of domestic and foreign research results, main source journals, main representatives, and cooperative relationships. An overall summary of progress in the research field, etc. Apply the citespace6.3 software and set up network nodes such as "keyword", "author", "institution" and "cited author" respectively, and obtain relevant indicators and knowledge maps to understand the research progress in the field of waterfront space design.

2.2. Data source

In order to ensure the objectivity and completeness of the research, the data used come from the Chinese Social Science Citation Index (cssci) included in the China National Knowledge Infrastructure (cnki) database and the English Social Science English Index of the WOS (web of science) network data center. (ssci for short). The academic level and cutting-edge research of the citation databases in WoS and cnki are relatively more reference and have wider research influence. Set the keywords in the database to "waterfront space, urban waterfront" and "Waterfront space"(Fuzzy search) Urban waterfront (precise search) retrieved a total of 490 articles from January 2000 to January 2023 for the subject words. The search results were integrated and deduplicated, and conference introductions, reviews, briefings and other types of documents were eliminated. As The research object of this paper.

3. Spatio-temporal Atlas of Urban Waterfront Space Research

3.1. Number of publications

The total number of research publications in a field represents the current level of theoretical development of research in this field, and the annual publication dynamics also reflect the continuous change of research in this field. It can be seen from Figure 2 that the research on coastal space design has been showing a gradual increase in the dynamics

of foreign publications, without excessive increase, and there is also a part of the gap between English search terms in the data, and the number of articles searched is not as good as the number of domestic literature, which is relatively small, but it can also reflect the phenomenon that the research hotspot is increasing year by year in the reference value. In China, the research on "waterfront space" showed an overall increase in the number of districts, which showed a slight fluctuation from 2011 to 2014, and increased year by year from 2015 to 2022, until the highest number of papers published annually reached 240 in 2021, more than four times that of foreign countries in the same year. In the past three years, the attention has continued to increase, and by 2021 China has become one of the main research countries on this topic.

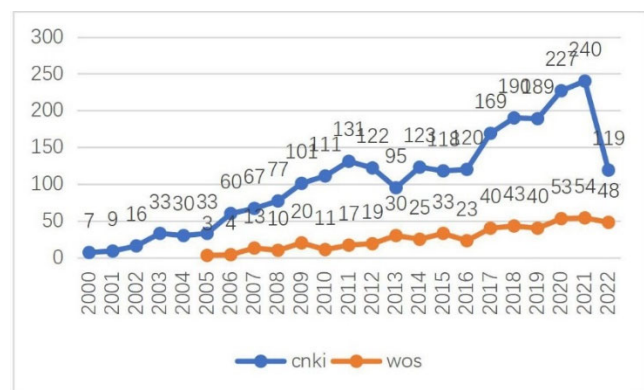


Figure 2. Table of the number of papers published in CNKI and WOS on the theme of "Waterfront Space" from 2000 to 2023, the picture shows the author's own drawing

3.2. Regional distribution characteristics

Table 3 shows the top 7 countries and regions in the WOS website by the number of publications, namely Spain, the United States, China, Portugal, Italy, the United Kingdom, and Australia (in order, the top 7 countries in the world). It can be seen that although China has paid relatively late attention to research in this field, its attention has been increasing year by year in recent years, becoming one of the top three countries in this field.

From the perspective of domestic institutions, top universities located in first-tier cities such as Shanghai, Beijing, Guangdong, and Nanjing have more research content and published publications. level difference. Among them, Tongji University accounts for the largest proportion of the country's total research literature, and its degree of relevance is also the largest, slowly extending to Southeast University, South China University of Technology, Beijing Forestry University, etc. The School of Architecture and Urban-Rural Planning of Tongji University is the main research institution for waterfront space design in my country.

Table 3. The picture of the top 7 countries in the WOS website by the most posts

Country	Count
Spain	81
United States	57
China	47
Portugal	37
Italy	30
United Kingdom	23
Australia	21

3.3. Representative point of view

As can be seen from Figure 4, Zhu Xigang, Song Weixuan, and Shen Xuwei have the largest number of papers on the theme of waterfront space design in China. Among them, Zhu Xigang and Song Weixuan (Song Weixuan, 2009) reflected on the current situation of waterfront public space in Nanjing, and proposed that the production of waterfront space should be balanced, such as the pursuit of economic benefits, social equity and spatial justice, and the public attributes of waterfront space need to be protected by legislation and the government. Some of the proposed regulatory measures on how the government can do to ensure that the waterfront space is owned by all people, and to maximize the comprehensive value of the waterfront public space. Song Weixuan, Zhu Xigang and Wu Qiyan (Song Weixuan, 2009) introduced the theory of space production into the discussion of urban waterfront space development in China in "The Efficiency and Equity of Urban Waterfront Space Production: A Case Study of Nanjing", reflected on the current situation of waterfront space production, put forward planning suggestions for China's waterfront space production, and advocated the establishment of a white line system for urban

planning.

In addition to the analysis of the authors with the largest number of published papers, the most referenced and cited literature in CNKI's database and the four most downloaded documents this year are tabulated and summarized in Table 4, in which Wang Jianguo and Lv Zhipeng's "Historical Experience of Ice Water Development and Construction in World Cities" makes a detailed analysis of the motivation and case analysis of the waterfront development of world cities, and puts forward the reference and learning value of China's future waterfront design with case analysis. Wang Zuo's "Enlightenment of the Revival of Urban Waterfront Open Space to China" uses positive measures in Europe and the United States to trigger the revival of urban vitality by urban waterfront space. Most of the earlier papers are based on the urban waterfront space of developed countries, and put forward suggestions for China's waterfront space, and the research on waterfront space planning, urban vitality, blue space and water field construction in the context of aging in these high-citation literatures, among which design planning is mentioned in four literatures, reflecting that there is a great deal of concern about the restoration of urban vitality in waterfront urban space in China.

Table 4. The author of the most topic posts crawled by citespace

Count	Year	Author
5	2009	Xigan Zhu
4	2009	Weixuan Song
4	2011	Xuwei Shen
4	2010	Junyan Yang
3	2019	Zi Zhang
2	2014	Dangzi Wu
2	2014	Xi Zhou

Table 5. The four most cited and downloaded articles in recent years

Number of citations	Author	Title of the paper	Year	Main points
1051	Wang Jianguo, Lu Zhipeng	The historical process and experience of the development and construction of urban waterfronts in the world	2001	In general, the background and internal motivation of the development and construction of urban waterfronts in the world are discussed, and the successful experience and failure lessons in practice are analyzed through case studies, and five conclusions worthy of China's attention in the future are proposed.
89	Wang Zuo	The dynamic revival of urban waterfront open space and its implications for our country	2007	This paper summarizes and analyzes the transformation experience of European and American countries in practice by using a variety of measures to transform the urban waterfront open space to carry out positive urban vitality revival, which has positive reference significance for the current urban transformation in China.
819	Yanan Tang, Lin Li, Lei Han, Shuanyu Xie	A review and enlightenment of research on the transformation and development of urban waterfront space in foreign countries	2022	On the basis of collecting and sorting out many relevant research literatures in China in recent years, this paper attempts to systematically summarize the research on urban waterfront space from the aspects of development and utilization, planning and design, physical landscape design, development planning and management, and the relationship with waterfront cities, and looks forward to the research trend from the aspects of systematization of waterfront air research, the application of new concepts and technologies, and the feasibility of strengthening development planning and management.
460	Tianjiao He, Qixiao He, Shaohua Yang	Research on the planning path of urban blue space to promote the health of the elderly	2022	In the context of reflecting on China's blue space and the current construction of the real national border, this paper proposes an urban blue space planning network to achieve the goal of elderly health, including the definition of planning elements and the support of planning tools. Focusing on the planning achievements and implementation results of China's frontier exploration, nine types of planning strategies are proposed under three goals: ensuring the efficiency of water cycle, ensuring the convenience of suitable water places, and eliminating water contact barriers.

4. Research Hotspot Analysis

Using CiteSpace software, select the "keyword" option to conduct commonality analysis (the frequency of keywords in different documents and the correspondence of related words) to form a related network knowledge graph. Taking 2000-2023 as the time slice, the top 10 hot words in the common frequency ranking were selected, and the frequency, centrality and year of occurrence were counted. From these three parts, a consensus network graph is formed, so as to analyze the connection and evolution of keywords Figure 6.

Figure 6. Waterfront space theme: Chinese literature, hot keywords, word frequency and related attributes

Keyword	Count	Intermediary Center Volume	Initial appearance
Waterfront space	69	0.42	2000
Urban design	30	0.21	2001
Public spaces	17	0.08	2010
urban renewal	14	0.006	2011
Synergistic development	3	0.01	2014
Urban dynamism	3	0.01	2020
Cultural communication	3	0.01	2021

4.1. The distribution structure of the city's watershed space

As you can see from Figure 7, the top 7 keywords about waterfront space are among the top 7 keywords. This kind of thematic research mainly comes from urban design, environmental design and other related disciplines such as urban design, public space, urban renewal, coordinated development, urban vitality, and cultural communication. In the disciplinary background of design, the concept of urban waterfront space refers to the open space of the waterfront space of the city's seaside riverside lake, such as waterfront squares, urban trails, ecological green spaces, riverside blocks and other external urban public spaces, but this refers to more physical space, and it can also be regarded as a mobile phone means of design activation in the revival of cross-professional waterfront space planning. At most, this article will sort out the research directions and current hot spots of urban waterfront space, and discuss the future prospects of urban waterfront space.

4.2. The evolution of the time zone of the city's watershed space

In order to analyze the time progress of keywords, the map of hot keywords is obtained according to the frequency and initial year in the software. According to the size of the nodes in the map, the frequency is obtained, and the new hot words derived from the research hotspots are made easier to understand the emergence of hot keywords in a certain annual time zone, and it is easier to compare the current research results of our city's waterfront space design and the research

hot words of the benchmark. Table 7 shows the time zone change map of keywords in Chinese literature, including waterfront cities (first appeared in 2002), waterfront (early 2002). Hot words such as 2003), waterfront (2004), strategy (2004), landscape (2007), ecology (2008), mountain city (2014), urban form (2015), urban renewal (2011), urban dual repair (2018), and urban vitality (2020). In recent years, "urban renewal" and "urban dual cultivation" have emerged in an explosive period, followed by new research hotspots such as urban renewal, urban dual cultivation, and urban morphology.

Table 7. The time zone change map of keywords in Chinese literature

Year	Keywords
2000	Waterfront space, urban design, human settlements
2005	Scenic forests, river ecology, and water system control
2010	Landscape city, public space renewal, form, Copenhagen park design
2015	Urban waterfront, architectural complexes, urban forms, recreational spaces, mountain cities
2020	Urban dual repair, urban vitality, ecological restoration, ecological civilization, and water system relocation

5. The Evolution of Urban Waterfront Space Research

By tracking and sorting out the research context, researchers can better obtain the latest research directions and grasp research trends. In CITESPACE, the research context of China's waterfront space in the past 20 years is divided into three stages by using high-frequency word emergence to analyze and grasp the research literature, better detect the emergence of related research trends, and combine the high-frequency application literature of various stages of the application of high-level emergence.

5.1. Early stages

The early research period was from 2000 to 2007, and the main journals published were "Research on Urban Waterfront Landscape Design", "Urban Waterfront Spatial Environment Design and Urban Function", "The Vitality Revival of Waterfront Open Space and Its Enlightenment to China", and the research on the relationship between waterfront space and city can be traced back to the urban planning and construction of "mountains and rivers" in ancient China (Ma Zhenglin, 1999), and our current research on the relationship between waterfront and city is only more than 20 years of history. Ma Zhenglin believes that the reason why ancient Chinese sites tended to be along the water's edge was to solve the problems of urban transportation and water use. The space field with the greatest advantage of the coastal space of the city, the basic public activity space for urban residents, is an important node of the city's image, and it is also a place for foreign tourists to start tourism activities. Guo Hongyu (Guo Hongyu, 1998) summarized the functions of waterfront space: practical value, ecological value and landscape value function. Scholars of urban planning can use the construction of waterfront space to increase the capacity of urban land area and improve the treatment of urban environment, so as to trigger new vitality and vitality for urban development. (Gong Weichao, 2001) believes that the layout of urban functions is

reasonable and the transportation is coordinated and the flood control system of the waterfront area to discuss the significance of waterside space in urban space.

It is more about the qualitative research on the analysis of the significance of waterfront space and public space and the theoretical part, and the planning and design of urban waterfront, physical landscape design, and planning and development to understand how to do urban waterfront.

5.2. Interim study

The mid-term research period was from 2007 to 2014, and the main journals were Architectural Journal, Urban Planning, Urban Development Research, and Planner, among which the most cited literature included "Exploration of Urban Design in Waterfront Area", "Commonality of Urban Waterfront Space and Planning Thinking", "Revival of Urban Waterfront Vitality and Its Enlightenment to China" From the perspective of context, the research on waterfront space in this period gradually changed from the initial study of the large-scale perspective of waterfront space to the detailed exploration, summarized the basic concepts and development models of urban waterfront areas, and also gained inspiration from individual cases to enlighten the urban waterfront open space in China DONG Ke. For example, since 2000, London, England, has renovated the Thames Riverside space, highlighting the block diversion of the riverside area, and adding complex open spaces such as culture and art, entertainment and play, finance and commerce, so as to make the Thames River have a variety of tourist functions and attract tourists and residents to the waterfront effect center. In Europe, most of the waterfront space management adheres to the introduction of cultural functions, coupled with the intervention of art and culture such as museums, art galleries, opera houses, etc., showing the most vibrant and changing waterfront landscape in the city. This approach can be seen in the renewal of old cities such as the Seine in Paris, the waterfront in Barcelona, and the new residential district of Amsterdam. (Wang Zuo, 2007) The Vitality Revival of Waterfront Open Space and Its Enlightenment to China.

The planning of tourism activities for the development of waterfront space and the interpretation and creation of cultural space from a cultural perspective. Huang Tai's "Research on the Organization and Planning Model of Urban Water Tourism Based on the Interpretation of Cultural Space - Case Study of Water Tourism in Suzhou Huancheng River" discusses the core of the organization and planning of the water tourism system is the interpretation and creation of cultural space. Taking culture as the soul of tourism development and space as the carrier, it is concluded that the design of water tourism has the composite characteristics of landscape, ecology and tourism. Therefore, the research of waterfront space not only stops at urban planning, but gradually stimulates a part of waterfront space services and urban culture from multiple perspectives, not only the integration of physical space, but also excavates and organizes at the cultural level.

5.3. Latest research

The latest research is from 2015 to 2023, and the main journals are Architectural Journal, Urban Planning, Urban Development Research, and Planner, among which the most cited literature is "The Prosperity of Di'an: The Revival of Waterfront Public Space in the South Section of Yangpu Riverside in Shanghai", "The Renewal and Development of

Waterfront Space and Paradigm Change under the Guidance of Urban Dual Cultivation: Analysis and Enlightenment of Suzhou Creek and Emche River", "Design Strategy of Urban Waterfront Space Based on the Concept of "Urban Dual Cultivation": A Case Study of Qingshui River Waterfront Space in Zhangjiakou City. In "The Renewal and Development of Waterfront Space and Paradigm Change under the Guidance of Urban Dual Cultivation: Analysis and Enlightenment of Suzhou Creek and Emche River", Wang Min excavates how urban waterfront space takes "ecological restoration and urban repair" as the core, reflects the reality of urban dual cultivation under the Neolithic waterfront space, and guides the comprehensive revival of waterfront space to provide a comprehensive and effective endogenous driving force for ecology. Wang Weiqiang's "Research on the Evaluation of Waterfront Public Space Vitality Based on Multi-source Data: A Case Study of Huangpu River Waterfront" introduces quantitative analysis to explore the development vitality of different waterfront spaces and different houses under digital development, studies the impact of urban hinterland development on the vitality of waterfront public space, and uses only identification and evaluation data to intervene in the development strategy of urban vitality areas, so as to provide theoretical support and optimization directions.

6. Conclusions and Development Trends

Looking at the research results of waterfront urban space in the past 20 years, the research hotspots include the morphological layout of urban waterfront space, the social value of urban waterfront, and the study of urban vitality with comprehensive data. In recent years, the field of urban sociology and commercial tourism has begun to study urban waterfront space, and a considerable number of papers have been published, but the research members and institutions are relatively scattered, and there is no trend of cooperative research.

With the attention and deepening of waterfront development in China's major cities, the practical dilemma of waterfront space utilization is gradually amplifying, and the attention to people of all ages is increasing. It is worth further research to strengthen the systematization of research and coordinate the relationship between multiple elements to protect the natural environment and human environment, and to protect the green space and the waterfront space where the corridor continues to extend.

With the progress of science and technology, digital management will also become an important technical means for waterfront space governance, and will also become a new hot spot in recent years in the academic research of waterfront space, and become the main research direction of waterfront space in the future. Looking forward to a wider range of future research at the intersection of engineering and technology, as well as economics, management and other social science disciplines.

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