

Research Hotspots and Prospects of Third-Tier Construction Industrial Heritage

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How to cite this paper: Chen, Y.Y. and Xiang, M.M. (2022) Research Hotspots and Prospects of Third-Tier Construction Industrial Heritage. *World Journal of Engineering and Technology*, 10, 473-486.
<https://doi.org/10.4236/wjet.2022.103028>

Received: June 8, 2022

Accepted: July 16, 2022

Published: July 19, 2022

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Abstract

From the perspective of bibliometric analysis, based on the data of 286 related literature retrieved and screened in the CNKI database, coOC software is used for data processing, and the relevant knowledge graphs such as the amount of publication, authors, and keywords in the field of third-line heritage research are plotted. The results show that the attention to third-line heritage research in China is increasing day by day, and the overall volume of publications shows a rapid growth trend; The authors' clusters are scattered and do not form a broad and close network of cooperation; The research hotspots focus on the protection and reuse of third-line heritage, and the quantitative research methods are insufficient. In the future, the breadth and depth of third-line heritage research need to be expanded.

Keywords

Third-Line Heritage, Bibliometrics, Visual Analysis, Research Hotspots and Prospects

1. Introduction

The construction of the third line refers to a large-scale industrial transportation and national defense science and technology industry construction centered on war preparedness in China from the 1960s to the 1980s due to the grim international situation and under the instructions of the CPC Central Committee. From the administrative point of view, it includes the vast mountain hinterland east of Wusheling in Gansu, west of the Beijing-Guangzhou Railway, south of Yanmen Pass in Shanxi, and north of Shaoguan in Guangdong [1]. After 16 years of construction, spanning 13 provinces, more than 4 million people have migrated to inland areas, nearly 10 million people have participated in the construction, a

total investment of 205.2 billion yuan, and more than 2000 large and medium-sized projects [2] have been built, leaving a large number of industrial heritage. Third-line heritage refers to the industrial relics produced during the construction period and region of the third-line construction, including material industrial relics such as industrial buildings, production plants, living housing, and non-material industrial relics such as technological processes, entrepreneurial spirit, science and technology, which have the universal value of industrial heritage.

For a long time, people have lacked a holistic understanding of the value connotation of the third-line heritage. This is mainly because most of the third-line projects are related to war preparation and national defense construction, and the projects are highly confidential. Since the 1980s, with the declassification of relevant documents and archives, the study of third-line heritage has gradually entered the field of academic research. A number of academic seminars on the theme of third-line construction research have been held nationwide, such as the “Memory and Heritage: Third-line Construction Research Summit Forum” held in Yichang, Hubei Province in 2019, and the Third National Third-line Construction Seminar held in Mianyang, Sichuan in 2021.

Based on the bibliometric method, using the literature data in the CNKI database, and using COOC software to draw the knowledge graph of the volume, author, keyword collinear, etc., this paper visually analyzes the research status and hot spots of the third-line heritage, in order to reflect the basic situation of this research field more objectively, comprehensively, dynamically and vividly, and explore the hot spots and research trends of the third-line heritage research, aiming to promote the vigorous development of china’s third-line heritage research.

2. Research Methods and Data Sources

2.1. Research Methods

The scientific knowledge graph is a kind of graph reflecting the development process of scientific knowledge and the relationship between knowledge structure, which can enable researchers to understand specific research areas, correlations and new points of interest through means such as data mining, information processing, knowledge measurement and mapping. This paper adopts the bibliometric analysis method, uses COOC¹ software to process the samples, selects the amount of text, authors, keywords as the main discriminant indicators, and also uses VOSviewer software to visually analyze the main contents of the study.

First of all, descriptive and visual analysis of the time change law and author of the literature is carried out in order to clarify the development context of the three-line heritage; Secondly, the keyword co-occurrence and keyword clustering of the literature are analyzed, and the research hotspots of the third-line her-

¹The COOC software is jointly developed by the Wechat public platform “Academic drip” and “bibliometry” team, and is used for the production of multiple types of matrices and network maps.

itage are explored; finally, the key word evolution trend of the third-line heritage is drawn to explore its development trend.

2.2. Data Sources

Based on CNKI database, the “advanced search” mode is adopted to search by subject words to ensure the comprehensiveness and accuracy of literature analysis. The “three-line construction” and including “heritage” were set as the search subject, the matching method was “exact”, and the search time was from the beginning year to December 31, 2021. The important data in the document was exported in Refworks format as a sample for analysis, the retrieved literature was filtered (non-research literature such as announcements, essays, conference notices, etc.) was manually excluded, the COOC software was used for literature inspection and deduplication, and synonymous combination of keywords was obtained, and finally 286 literature were obtained as research samples (see **Table 1**).

3. Analysis of the Current State of the Study

3.1. Analysis of the Current State of the Study

After statistical analysis of the literature, it is found that the research on third-line heritage in China has shown a rapid upward trend. As shown in **Figure 1**, the volume of publication of three-tier heritage studies can be divided into three periods:

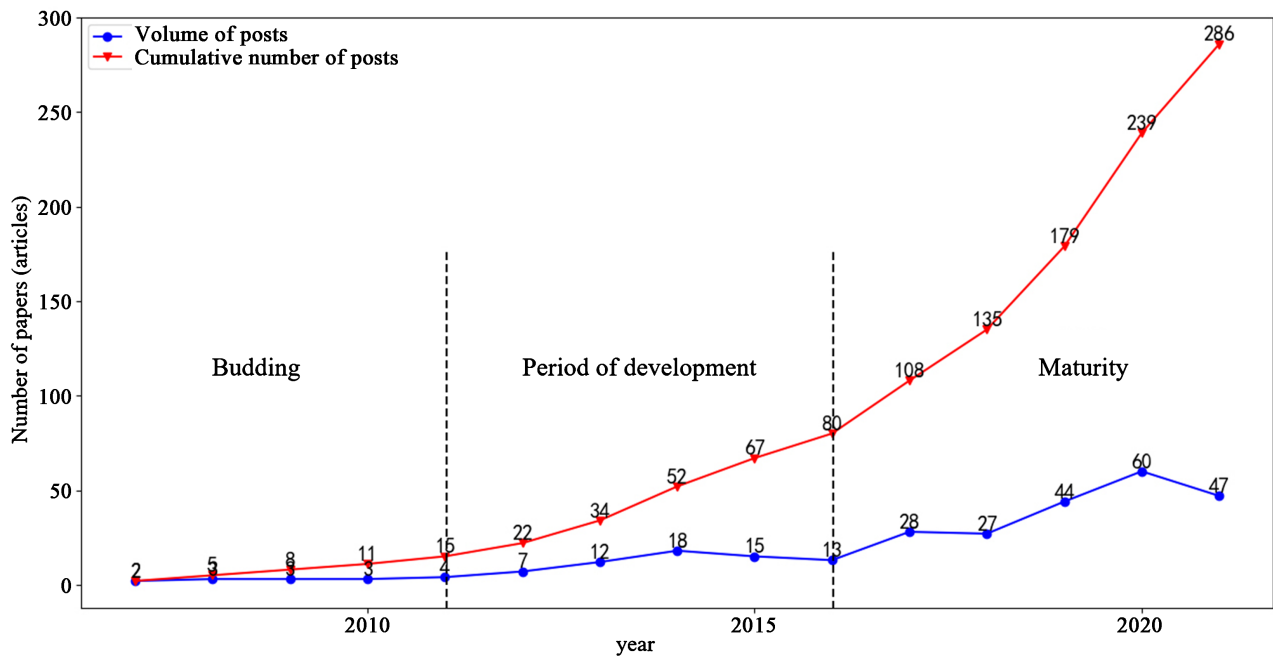
1) 2007-2011 is the embryonic period, this stage of the volume of publication is small, the average annual cumulative volume of nearly 3 articles (the earliest literature on the study of the third-line heritage is Mr. Chen Donglin’s “Three-line Construction, the Nearest Industrial Heritage” published in The National Geographic magazine of China in 2006, because the document is not included in CNKI, so the literature is from 2007), and the overall trend can be seen to be slowly rising.

2) 2012-2016 is the development period, because in 2013, in order to comprehensively promote the adjustment and transformation of the national old industrial base, the state formulated the “National Old Industrial Base Adjustment and Transformation Plan (2013-2022)”, which includes the industrial base during the

Table 1. Retrieving the selection conditions and the results.

Class	Explain
Data sources	CNKI data base
Retrieval time	From January 2000-December 2021
Type of literature	Journal, master and doctoral thesis
retrieval mode	Theme = “third-line construction” and includes “heritage”
Retrieve results	There are 193 journal papers and 93 degree dissertations

Source: The author sorts it out and self-makes it.



Source: Authors organize their own work.

Figure 1. Distribution of publication volume and cumulative publication volume of third-line heritage research (2000-2021).

third-line construction period, which marks that the third-line heritage has received national attention, so the amount of documents issued is significantly more than the previous stage, the growth rate is faster, and the average annual cumulative number of documents is nearly 13.

3) 2017-2021 is the mature period, because China announced the first batch of national industrial heritage list for the first time in 2017, heavy steel section steel mills and other third-line construction industrial heritage was included in the list; In addition, in 2017, the State Administration of Cultural Heritage said in its reply to the “Proposal on Strengthening the Protection and Utilization of Heritage Resources in the Third-Line Construction” submitted by Jiang Gangjie, a member of the National Committee of the Chinese People’s Political Consultative Conference, that it would actively unite relevant departments and coordinate with the people’s governments of relevant “third-tier” cities to take effective measures to continuously improve the level of third-tier heritage protection [3]. Since then, the attention to this issue has become increasingly high, so the number of articles published at this stage has surged, with an average annual cumulative volume of nearly 41 articles. It is foreseeable from this trend that more scholars will conduct research on third-line heritage in the future, reflecting that there is still a large research space in the field of third-line heritage.

3.2. Authors’ Analysis

The subject area of a scholar’s research is closely related to the results of his academic papers, and when a scholar publishes a certain amount of papers in a certain field, the scholar can be regarded as belonging to the field [4]. The COOC

software is used to analyze the volume of posts and cooperation of relevant authors, and its node size indicates the number of articles published by the scholar in the field of third-line construction, and the thickness of the connection between nodes indicates the strength of the cooperative relationship.

As can be seen from **Table 2**, the core authors in the field of third-line heritage research mainly include Xu Youwei (9 articles), Tan Gangyi (6 articles), Daniel Zhang (5 articles) and others. Scholars engaged in the study of third-line heritage have mainly formed two major author cooperation networks, specifically Xu Youwei, Tan Gangyi, Daniel Zhang, Xu Liquan, etc., and Chen Yurong, He Linjun, Ai Daiwen, Zhu Tingting, Yu Minghong. The number of articles and the number of people published by these two major cooperation networks is relatively large, and the intensity of cooperation is relatively large. There are also some small cooperative networks. On the whole, the third-line heritage research has not formed a broad and close author cooperation network, and author cooperation needs to be strengthened.

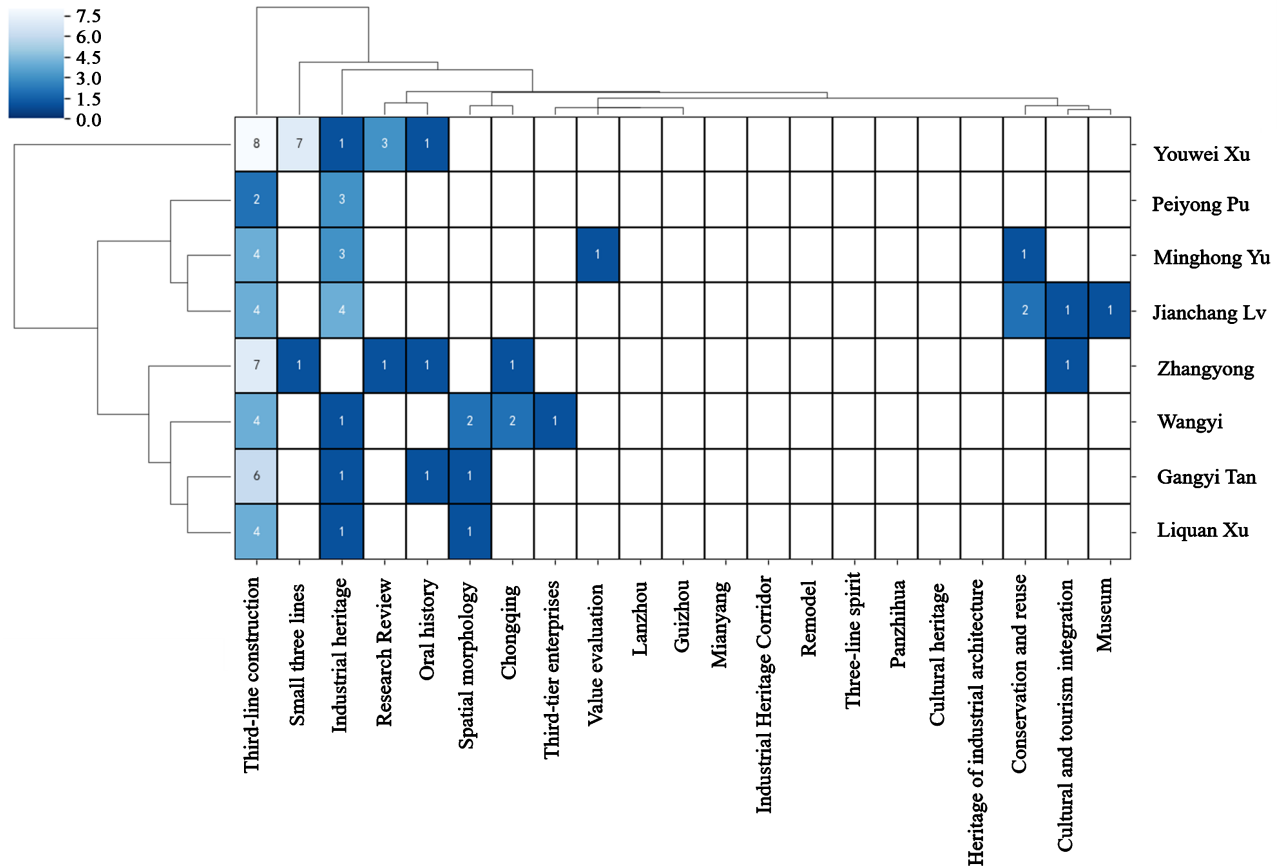
In order to understand the research subject areas of third-line heritage researchers, the authors and keywords were analyzed in a binary clustering analysis. Specifically, by selecting all authors who have published 4 or more articles in the field of third-line heritage and have a theme frequency of 4 or more times as research objects, the author-theme binary cluster is constructed (see **Figure 2**).

It can be intuitively seen that “three-line construction” and “industrial heritage” are the keywords of basic research, and a large number of authors are gathered; there are also node themes that form strong correlations with specific scholars. For example, Xu Youwei and Daniel Zhang published high-quality results in the construction of the small third line and the research review; Lv Jianchang has done a lot of research on the protection and utilization of third-tier

Table 2. High-frequency authors and highly cited documents in third-line heritage studies (post volume 4).

Order number	Author	Post volume	The most frequently cited literature in the No
1	Xu Youwei	9	Research and review on the third-line construction in the past five years
2	Tan Gangyi	6	China's collective shape system and its construction environment and space will to explore the hidden
3	Zhang Yong (outside Sichuan)	5	The Third Line Construction in the Vision of Social History
4	Xu Liquan	4	Research on third-line Construction Heritage Based on Industrial Archaeology
5	Pu Peiyong	4	——Takes the transformation of Panzhuhua Xi Lawn Industrial Site area as an example
6	Lu Jianchang	4	Current situation and research countermeasures: focus on the protection and utilization of the third-line construction of industrial heritage
7	Yi Wang	4	Development and layout of Chongqing military enterprises in the third-line construction
8	Yu minghong	4	Status and protection mode of Mianyang

Source: Authors organize their own work.



Source: Authors organize their own work.

Figure 2. Author of a three-line heritage study—Thematic binary clustering diagram.

industrial heritage; Pu Peiyong takes ecological values and cultural landscapes as the starting point to study the transformation path of old industrial areas; Tan Gangyi and Xu Liquan explored the spatial layout of the third-line heritage based on multidisciplinary methods such as archaeology and typology; Wang Yi mainly focuses on the development and industrial layout of third-tier enterprises in Sichuan and Chongqing; Yu Minghong uses Mianyang City as a research site to conduct value assessment and conservation and utilization research from macro to micro aspects.

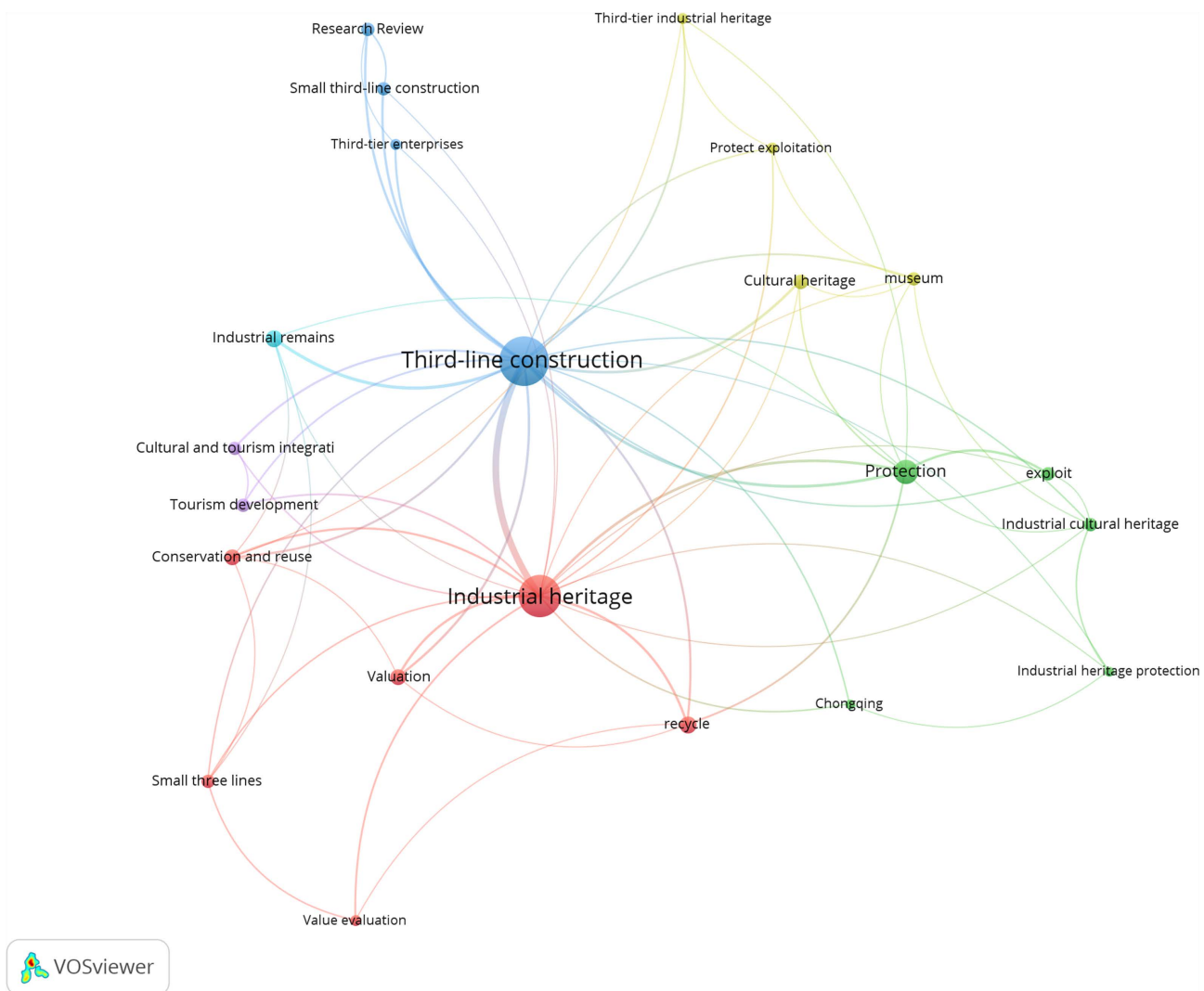
4. Research Hotspot and Trend Analysis

4.1. Research Hotspots

The co-lexical characteristics of keywords in the literature can reflect the current research hotspots. Researchers can directly analyze the topics in the field of study through the results of the common word. The co-occurrence frequency of keywords determines the intensity of hot spots, and the association relationship of keywords in the co-word network determines their centrality [5]. In the key word collinear, the size of the node is positively correlated with the frequency of the keyword, and the thickness of the line is positively correlated with the degree

of co-occurrence. In order to understand the origin and development status of the third-line heritage research, coc and VOSviewer software were used to visualize the keywords, and **Figure 3** was a co-occurrence spectra of 22 high-frequency keywords with more than 5 occurrences.

In terms of the frequency of keywords, in addition to the two basic research hot keywords of “three-line construction” and “industrial heritage”, the main research hot keywords are “protection and reuse” (75 times), “value evaluation” (20 times), “cultural heritage” (19 times), and “small third line” (17 times). In addition, keywords such as “cultural and tourism integration”, “research review”, and “industrial architectural heritage” also show a certain degree of popularity (**Table 3**). This shows that the academic research on the third-line heritage mainly focuses on how to protect and reuse the heritage. The specific process is to first collect data and conduct field investigations of the third-line heritage, and then establish a value appraisal system, evaluate the value of the third-line



Source: Authors organize their own work.

Figure 3. Glossary of keywords in the third-line heritage study.

Table 3. Frequency of co-occurrence of keywords in third-line heritage research (>5).

Order number	Keyword	Co-occurrence frequency	Order number	Keyword	Co-occurrence frequency
1	Third line construction	155	12	museum	8
2	Industrial heritage	124	13	transform	8
3	Protection and reuse	75	14	Spatial form	8
4	Value evaluation	20	15	Chongqing	7
5	cultural heritage	19	16	Chengkun railway	7
6	Small three lines	17	17	cultural landscape	6
7	Panzhuhua city	14	18	Yichang	6
8	Cultural and tourism integration	12	19	Three line spirit	6
9	Research review	11	20	Third-line enterprises	6
10	Industrial building heritage	9	21	Mianyang City	6
11	Industrial heritage corridor	9			

Source: The author sorts it out and self-makes it.

heritage, and then carry out multi-disciplinary and multi-dimensional transformation and design strategies, such as the integration of culture and tourism, the construction of museums, etc. The research objects range from macro to micro, including regional linkage (key areas of third-line construction, industrial heritage corridors, etc.), and focus on the architectural level (industrial architectural heritage, spatial form, etc.).

4.2. High-Frequency Keyword Clustering Analysis

Research clustering is based on the hot spot network map through refining and summarizing the formation of research themes, visually displaying the main research areas. The principle is to generate knowledge clustering through the graph clustering algorithm, and extract the label subject words through the algorithm to characterize the corresponding research frontier areas [6]. The high degree of overlap between studies and the closest correlation between hot words show that co-citation between two clustering units is very common, while the correlation between other clustering units is poor.

Using COOC software to cluster high-frequency keywords, on the basis of research hotspot analysis, combined with the actual situation of third-line construction research, it can be summarized as follows: the theoretical architecture of third-line heritage (C0), the spatial layout and urbanization development of third-line construction (C1), the value assessment of third-line heritage (C2), and the protection and reuse of third-line heritage (C3).

1) The theoretical framework of the three-tier legacy

The third-tier heritage occupies an important position in China's modern industrial heritage and has a far-reaching impact on the development of provinces

and cities involved. High-frequency keywords such as “cultural heritage”, “industrial architectural heritage”, “cultural landscape” and “three-line spirit” appear frequently, indicating that a comprehensive understanding of the basic concept of third-line heritage is the premise for its protection and utilization.

Under the framework system of World Heritage and Industrial Heritage, Xu Songlin and Chen Donglin discussed the basic issues such as the concept, type and evaluation criteria of third-line heritage, which has far-reaching significance for the research of later scholars. In recent years, in addition to the detailed study of the material form of the third-line heritage, scholars have also elaborated in more detail on the intangible form of the third-line heritage. For example, Lv Jianchang *et al.* comprehensively explain the basic concepts through the analysis of the three dimensions of time, space and industry of the third-line industrial heritage and the specific description of the form, and the intangible form includes the macro strategic decision-making ideas and guidelines and policies of the third-line construction, the wisdom of the production organization and management of the third-line enterprises, the “three-line spirit”, the group memory of the third-line builders, and the technical and technological knowledge of the third-line enterprises. From the perspective of industrial archaeology [7], Tan Gangyi and others pointed out that the third-line heritage includes the cultural route of the three-line construction with industrial heritage as the main body, the core tangible cultural heritage such as the built environmental heritage, the industrial heritage, and the architectural landscape, as well as the cultural expressions such as related construction processes, technological processes, production skills, and intangible cultural heritage such as oral memory, collective form and the spirit of the times, which enrich the temporal and spatial types of the third-line heritage [8].

2) Spatial layout and urbanization development of third-line construction

The construction of the third line is the product of the special period of China’s “preparation for war” and “de-planning”, and it is also a special product of China’s exploration of industrialization and urbanization, and the planning layout presented by the third-line industrial heritage is quite different from the construction of ordinary industrial facilities. It is not only very directly related to countries and regions, for example, with geopolitics, military infrastructure, urban agglomerations, and railway distribution lines. And out of the consideration of combat readiness, the construction requirements of “large dispersion, small concentration, backing, and concealment” are generally followed.

Its hot keywords include “spatial form”, “third-tier enterprise”, “planning” and so on. The construction of the third line has had a vital impact on China’s economic and social development and has played an important role in the urbanization process of the whole country, especially in the western region. In 2021, China’s urbanization rate reached 64.72%, some cities to the outside “spread the pie” sprawl is not sustainable, China’s urban construction has gradually bid farewell to epitaxial expansion, turning to the stage of connotation development.

In the case that the incremental space in the old city has been saturated, a new round of urban space reorganization and material renewal is urgently needed. Through the review and reflection on the planning and layout of old industrial zones in third-tier cities, it is conducive to exploring the path of protection and reuse.

At the macro level, Xu Liquan *et al.* started from the perspective of urban and rural regional planning and layout, and with the help of morphological typology methods, carried out comparative research from four aspects: regional planning layout, urban and rural (factory and mine) form, community organization model, and architectural type style [9]. From macro to micro analysis, summarize the laws and characteristics of the planning layout, and analyze the characteristics of the planning layout of the third-line construction area and the factory and mine planning and layout in northwest Hubei as an example, highlighting the “small and complete” independent unit layout, and re-examining the contemporary value significance of the third-line construction from the perspective of heritage value [10]; from the research perspective of historical geography and industrial geography, Wang Yi analyzed the layout and characteristics of enterprises in the construction period of the third line in Sichuan, and discussed the relationship between spatial layout and industrial development [11].

At the mesoscopic level, Liu Fengling started from the construction of the shipbuilding industry heritage corridor, and through value assessment, constructed the overall pattern of the three-line heritage corridor according to the basic elements of the corridor [12]; starting from the research perspective of third-line military enterprises, Wang Yi analyzed the development and layout of Chongqing’s military enterprises during the third-line construction period, with a view to promoting the development of regional economy while achieving national defense and security as much as possible [13].

At the micro level, Li Dengdian *et al.* took the 102 machine repair plant in Zaoyang City, Hubei Province as an example, used architectural methods to sort out the planning layout, and studied the site selection and layout of the plant and mine, the functional group and the causes of the planning layout [14]; Yuan Lei *et al.* divided the remains of the third-line construction into three categories of “public buildings, residential buildings and production buildings”, and selected two typical buildings of clubs and residences for research, which is conducive to the protection and reuse of buildings [15].

3) Valuation of third-tier heritage

In terms of the valuation of the third-line heritage, literature analysis and fieldwork are common research methods, which can be widely used in the field of third-line construction research. In addition, scholars have also drawn on the theories and methods of archaeology, anthropology, architecture, political economy and other disciplines to study the construction of the third line. For example, Zhou Jian *et al.* constructed a research system and research methods for Guizhou’s third-tier industrial heritage based on industrial archaeology [16]; Liu

Hanxi took the relocation of the former third-line site in the former qianbei area of eastern Sichuan as an example, introduced the analytic hierarchy method to establish a value appraisal system, and combined quantitative and qualitative to make the research results more accurate [17]; from the perspective of international industrial heritage, Xu Songling analyzed the significance of third-tier industrial heritage based on the institutional value in political economy [18].

4) Protection and reuse of third-line heritage

How to protect and utilize is the purpose and significance of the third-line industrial heritage research. Many scholars have conducted relevant practical research on the protection and reuse of industrial heritage. Its hot keywords include “protection and reuse”, “small third line”, “cultural and tourism integration”, “industrial heritage corridor”, “museum” and so on.

From a macroscopic point of view, from the perspective of urban and rural location and functional use, Lv Jianchang first clarified the current situation of the protection and utilization of third-tier industrial heritage, and then proposed relevant countermeasures for building a database, solving financial difficulties, integrating tourism resources, exploring diversified third-tier museum construction, and strengthening basic theoretical research [19]. In view of the lack of integrity and regional status quo in the study of industrial heritage protection in China, some scholars have introduced the concept of heritage corridors. The conservation planning of the heritage corridor focuses on the integrity, starting from the overall spatial organization of the system. For example, Liu Fengling protects and utilizes the Chongqing section of the Yangtze River as a whole by constructing its heritage corridor, and then constructs a value assessment system at different levels [12]; Pei Ying can construct the third-tier riverside industrial heritage of the upper Reaches of the Yangtze River based on the holistic view, and conduct value assessment and conservation strategies [20].

From the perspective of microscopic cases, Gong Jiayi *et al.* [21] took the Southwest Yunshui Machinery Factory as an example and proposed a protection and reuse strategy from the characteristics of the cultural landscape; Wu Huirong *et al.* [22] took Pengzhou Guihua Town as the research object, analyzed the local third-line construction industrial cultural heritage resources, and proposed to build a global healthy cultural and creative tourism town; Yang Xiyu [23] Taking Panzhihua City as an example, he focuses on the use of research and study tourism, the launch of intangible cultural heritage tourism routes, and the integration with the construction of smart cities. In addition, Guizhou, Panzhihua and other provinces and cities have built third-line construction museums, preserving the memory of the times; Mianyang City, Sichuan Province, has made use of local red cultural resources to develop the Red Tourism Project of Liangdan City, which has been highly praised by General Secretary Xi Jinping [24].

At the same time, the investigation and research of the small third-line industrial heritage has also received the attention of scholars, Wang Weiliang and

others [25] taking the Shandong “small third-line” industrial heritage, Xinhua Sand Turning Plant as a sample, proposing protection and renovation strategies; Xu Youwei *et al.* [26] Taking Huoshan mountain in Anhui Province as an example, through fieldwork, summarize the experience of rural small and third-line industrial heritage protection and development and coordinated development of rural economy, so as to help rural revitalization; Wang Wenzheng [27] conducted field research on the “small third line” in the Yimeng Mountainous Area in southern Luzhong based on the field survey, and finally established a value evaluation system to evaluate it and proposed corresponding protection measures.

Acknowledgements

After more than ten years of development, China’s academic circles have produced many excellent achievements in the field of third-line heritage research, and the development trend is sufficient, but the breadth and depth of research urgently need to be expanded.

1) From the perspective of research objects, the construction of the third line spans 13 provinces and regions, and the region involves a wide range of regions, while the current stage of the third-line heritage research is mainly concentrated in specific areas such as Panzhihua, Chongqing, Yichang, etc. The research on the construction areas of the small third line and other provinces and cities in the third line needs to be expanded. In addition, in recent years, the development of ecotourism and national park system has promoted the development of economic ecology and ecological economy, and the protection and reuse of third-line heritage in the future can focus on the joint construction of auxiliary resources such as natural landscapes and recreation areas, and strengthen the multidisciplinary cross-integration research of third-line heritage.

2) From the perspective of research content, third-line heritage research mostly focuses on localization research, focusing on the protection and reuse of heritage, the research content is relatively concentrated, there are more homogeneous studies, the proposed strategies and measures are similar, the landing is not strong, and the definition of the concept of third-line heritage needs to be further expanded.

3) From the perspective of research methods, with the continuous deepening of the research of third-line heritage, the relationship between disciplines is getting closer and closer, but quantitative research is mostly concentrated in the analytic hierarchy method, and the value assessment method needs to be innovated, and the future can strengthen the discipline integration research of architecture, human geography, political science, sociology, anthropology, cultural relics and other multidisciplinary knowledge, and apply the research method to the research of the third-line heritage. With the public access to some local archives and the continuous collection of oral historical materials, the third-line heritage research in the new era will achieve more fruitful results.

Funding

Supported by “Sichuan Military-Civilian Integration Strategic Research Center Project” (JMRH-2009).

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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