

Progress and Prospects in Industrial Heritage Reconstruction and Reuse Research during the Past Five Years: Review and Outlook

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Abstract: The reconstruction and reuse of industrial heritage has constituted important means for the protection of that heritage, and has played a crucial role in promoting urban renewal and sustainable urban development. In this study, we reviewed 404 pieces of literature on industrial heritage reconstruction and reuse published in the past five years (January 2017 to August 2022), which includes the most representative studies (those published in key journals in the field) or the most influential studies (those highly cited). We then used three keyword tools (WordStat, Weiciyun and CiteSpace) and conducted keyword extraction, analysis and meaning presentation of 404 studies, finally identified three main research themes: (1) the current barriers to industrial heritage reconstruction and reuse, (2) the coping strategies for industrial heritage reconstruction and reuse, and (3) the evaluation of the effects of industrial heritage reconstruction and reuse. Our results revealed and clarified the latest trends in international research. Meanwhile, we also pointed out the inadequacies of the current research, such as ignoring important topics and the limitations of research methods. We hope that our research could inspire future research on industrial heritage reconstruction and reuse.



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Keywords: industrial heritage; barriers to reconstruction and reuse; strategies for reconstruction and reuse; evaluation of the effects of reconstruction and reuse

1. Introduction

1.1. Industrial Heritage Reconstruction and Reuse

Industrial heritage represents key historical material evidence that testifies to the development of human industrial civilization, industrial technology and industrial systems. It has important historical, social, scientific and aesthetic value. Since the International Committee for the Conservation of the Industrial Heritage (TICCIH) adopted the Nizhny Tagil Charter For The Industrial Heritage in 2003, the concept of industrial heritage has been clearly defined internationally; it consists of “the remains of industrial culture which are of historical, technological, social, architectural or scientific value. These remains consist of buildings and machinery, workshops, mills and factories, mines and sites for processing and refining, warehouses and stores, places where energy is generated, transmitted and used, transport and all its infrastructure, as well as places used for social activities related to industry such as housing, religious worship or education” [1].

Scholars have recognized that there are generally two ways to protect industrial heritage: specimen static protection and “development oriented” dynamic protection. The former focuses on “authenticity”, while the latter injects new vitality into industrial heritage based on this authenticity. By being “reconstructed and reused”, industrial heritage can fulfill current needs.

Paradoxically, there is no consensus about the concept of industrial heritage reconstruction and reuse. On the one hand, although the concept of “industrial heritage” has

been clearly defined in the Nizhny Tagil Charter For The Industrial Heritage, it is inseparable from the concepts of “industrial architecture”, “industrial land” and “industrial brownfield”. The reason for this inconsistent presentation is that different scholars belong to different disciplines or research fields, and their research perspectives are also varied. On the other hand, most researchers have shown that reconstruction and reuse are equivalent to adaptive reuse, temporary use, etc. They have not differentiated much between the terms in their research. For example, some researchers have noted that the concept of “reconstruction and reuse” was clearly defined in the Burra Charter adopted in 1979 [2,3]. Indeed, the Burra Charter uses the term “adaptive reuse”. A small number of researchers have shown a difference between the terms and proposed the concept of “reconstruction and reuse” [4]. Nevertheless, these scholars have not gone further and have not analyzed the concept deeply. This study shows that industrial heritage reconstruction and reuse has a specific meaning and application, and that it is necessary to clarify the terms to facilitate theoretical research that can serve practical projects.

As the words imply, industrial heritage reconstruction and reuse refers to the reuse of industrial heritage. It is possible to deconstruct the notion into “industrial heritage”, “reconstruction” and “reuse”. “Industrial heritage” is the object, and “reconstruction” and “reuse” are the means. Here, “reconstruction” is not an adjective but a noun that is juxtaposed to “reuse”. Both reconstruction and reuse are reflected in practice, but reconstruction and reuse are sequential, with reconstruction happening first, followed by reuse. In examining industrial heritage reconstruction and reuse from this perspective, we found that it is different from general industrial heritage reuse such as “adaptive reuse” and “temporary use”. Scholarly definitions have emphasized reuse on the basis of the preservation of original buildings, whether reuse entails “adaptive reuse” [5] or “temporary use” [6]. However, reconstruction and reuse has emphasized the means by which “reconstruction” occurs. Reestablishment, expansion, renovation, and refurbishment have been used when existing structures are not suitable for new purposes or are not safe enough to be retained [7]; these approaches can be incorporated in the concept of “reconstruction” because they conform to the concept of “reconstruction”. Therefore, compared with the general concept of reuse, “reconstruction and reuse” undoubtedly has greater meaning and relies on a wider vision. According to the definition, we contend that industrial heritage reconstruction and reuse should include the general reuse strategy of injecting new life into industrial heritage by preserving original buildings [5] and making functional changes [8]. Reconstruction and reuse should also entail reuse based on the reconstruction of the layout of the new buildings and spaces to infuse continuity in the spirit of the place. This approach includes five strategies, including internal juxtaposition, renovation and implantation, structural reconstruction, external juxtaposition, and reconstruction and expansion; these strategies constitute the conceptual framework for industrial heritage reconstruction and reuse, as shown in Figure 1. The framework is also the primary starting point of this study.

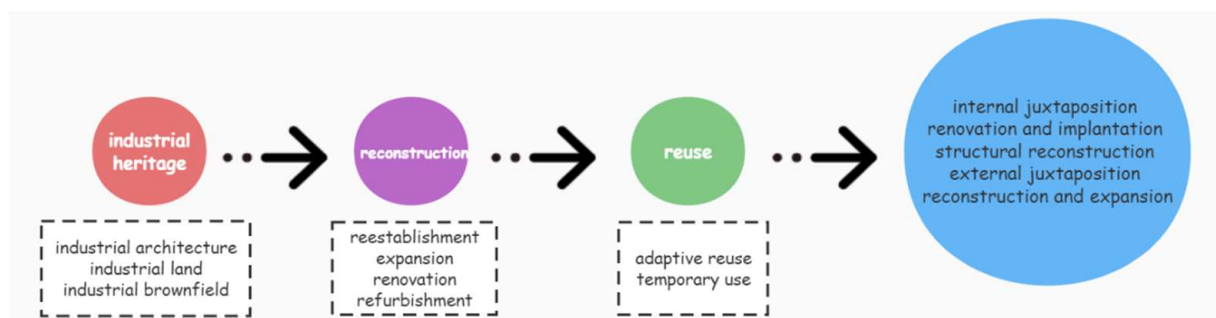


Figure 1. Schematic diagram describing the concept of industrial heritage reconstruction and reuse (by author).

1.2. Literature Review

The most recent studies have indicated the latest trends and directions in the field of industrial heritage reconstruction and reuse; in particular, research published in the past five years has been more representative and leading of the field. Therefore, in this paper, we reviewed the literature published from 1 January 2017 to 1 August 2022, and found that the authors of the reviewed literature came from Europe, North America, China, Japan, and even the Middle East. They include but are not limited to scholars, architects, government officials, and heads of associations, which shows the diversity of industrial heritage research subjects participants. Some independent literature is jointly completed by different people from different institutions, countries, and even fields, and the reviewed literature also appears in various forms. Hence, our literature review is not limited to journal articles, as it also includes books and monographs, dissertations, and conference papers, and this literature review is as accurate and complete as possible. As we assembled these different types of literature formats, we provided in this paper the state of the research on industrial heritage reconstruction and reuse.

1.2.1. Sources

Because there is no authoritative definition of industrial heritage reconstruction and reuse, the relevant research results have been scattered. To avoid omitting important documents, the scope of industrial heritage reconstruction and reuse must be appropriately expanded. First, based on common terms and concepts found in the literature related to industrial heritage and reconstruction and reuse, we created thematic keywords, which include industrial heritage, industrial architecture, industrial land, and industrial brownfield, and object keywords, which include reuse, reconstruction, renewal, and regeneration. Then, we grouped and classified these keywords to form 16 search strategies, as shown in Figure 2. Next, we used these strategies to search the literature that was published in the past five years (2017–2022) in the main retrieval channels of three types of literature: books and monographs (mainly Worldcat, Goodreads, Amazon, Z-Library, and Google Books), dissertations (mainly Worldcat and Google Scholar), and journal papers and conference papers (mainly Google Scholar, Web of Science, CNKI (China national knowledge infrastructure), and Worldcat). Eventually, 404 effective search results were obtained after preprocessing, by which duplicates and irrelevant documents were removed. We then analyzed the documents retained. According to our statistics, books and monographs account for 15.6% of our data sample, dissertations account for 17.1%, and journal papers and conference papers account for 67.3%. Moreover, the language distribution of the search results is wide, which reflects that research on industrial heritage reconstruction and reuse has been global in the past five years, as shown in Figure 3.

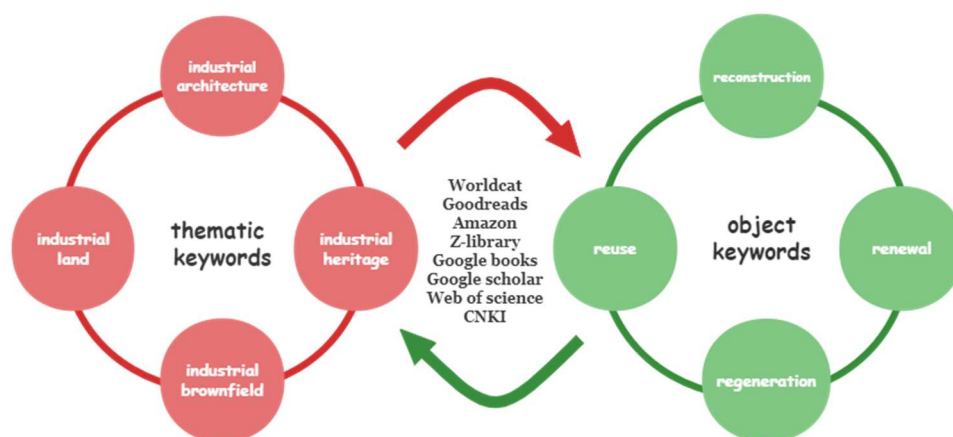


Figure 2. Research retrieval strategies (by author).

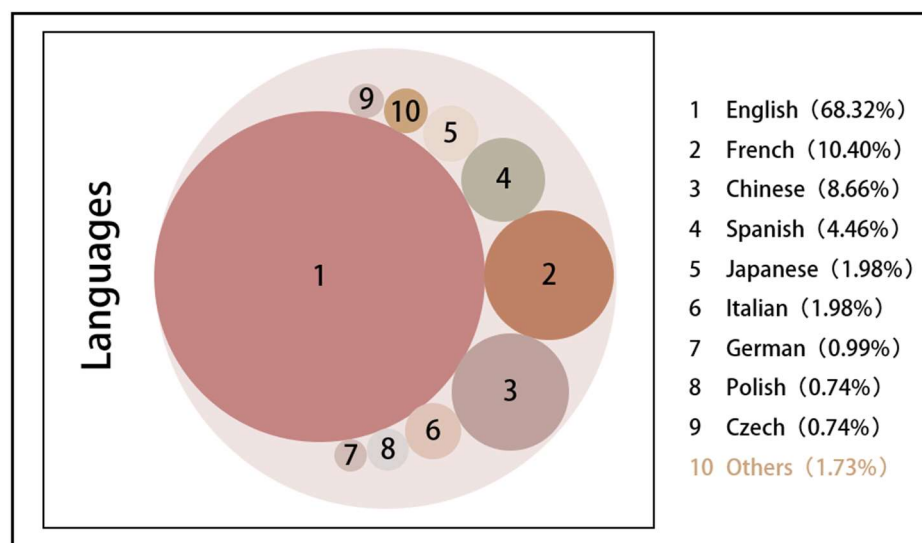


Figure 3. Language distribution of 404 literature samples (by author).

1.2.2. Description of the Literature

Out of the 404 studies reviewed, we used three keyword tools (WordStat, Weiciyun and CiteSpace) and conducted keyword extraction, text analysis and significance presentation of 404 studies, and finally identified three main research themes: (1) the current barriers to industrial heritage reconstruction and reuse, (2) the coping strategies for industrial heritage reconstruction and reuse, and (3) the evaluation of the effects of industrial heritage reconstruction and reuse. These topics have been recurrent in the research on industrial heritage reconstruction and reuse; however, other pressing issues have certainly emerged in the past five years, with corresponding innovations in research methods and perspectives. Based on our sample, we focused on new research trends to inspire future research on industrial heritage reconstruction and reuse and to fully reflect the progress this research has achieved in the past five years.

2. Current Barriers to Industrial Heritage Reconstruction and Reuse

Although industrial heritage reconstruction and reuse presents obvious benefits, “challenges and barriers involved make it futile and hard to obtain” [9]. André Fernandes, et al., highlighted the challenges and barriers of the reconstruction and reuse of waterfront areas by investigating the different foci of stakeholders, which they divided into six categories: governance (e.g., inconsistency of political vision, inadequacy of the intervention concept, inadequacy of the institutional model, inadequacy of institutional coordination, instability of the institutional model, lack of promotion and marketing); infrastructure (e.g., undefined structural projects, lack of accessibility); territory (e.g., size of the intervention areas, location of the intervention areas, metropolitan territorial model, land ownership issues); finance (e.g., lack of investment, financial liabilities, financial crisis, property market crisis); culture (e.g., industrial tradition, industrial stigma); and environment (e.g., environmental liabilities, climate change effects) [10]. These problems basically cover every aspect of the difficulties of industrial heritage reconstruction and reuse. In the past five years, research on the barriers to industrial heritage reconstruction and reuse has focused on some of these obstacles. Based on time limits imposed on the completion of any reconstruction and reuse project, these obstacles can be divided into financial and systemic barriers in the early stage of a project and into secondary problems in the latter stage of a project. Some representative literature is summarized in Table 1.

Table 1. Main literature on the current barriers to industrial heritage reconstruction and reuse.

Current Barriers		Author
Financial barriers		de Broekert, C., 2022 [9]; Yldiz, G., and Sahin Guchan, N., 2018 [11]; Dell'Ovo, M., et al., 2020 [12]; Merciu, C., et al., 2017 [13]; Nowogońska, B., 2020 [14]; Han, H., 2021 [15]; Kramářová, Z., 2018 [16]; Marian-Potra, A. C., et al., 2020 [17];
	Incomplete legal system	Merciu, C., et al., 2017 [13]; Fanlei, M., and Chaojie, Q., 2020 [18]; Sadowy, K., and Lisiecki, A., 2019 [19]; Sroka, B., 2019 [20]; Wen, W., et al., 2021 [21]; Xiangguan, G., and Jiang, C., 2017 [22]; Palomares Figueres, M. T., et al., 2018 [23]; Vecchio, M., and Arku, G., 2020 [24]; Gyurkovich, M., and Gyurkovich, J., 2021 [25];
Secondary problem	Hollowing out and nihilization	Preite, M., 2020 [26]; Yong, D., 2019 [27]; Xiaojun, F., 2017 [28];
	Densification	Merciu, C., et al., 2017 [13]; Adams, C., 2021 [29];
	Gentrification	Squires, G., and Hutchison, N., 2021 [30]; Wincott, A., et al., 2020 [31]; Tideman, S., 2021 [32]; Mathews, V., 2019 [33]; Goyer, R., 2021 [34]; Radziszewska-Zielina, E., et al., 2022 [35];

2.1. Financial Barriers

Most researchers have shown that the lack of sufficient funds is the most important barrier to industrial heritage reconstruction and reuse, and that industrial heritage reconstruction and reuse projects need to find appropriate and feasible implementation methods and financial instruments [9]. In practice, “few of them are restored under poor conditions as a result of financial profits” [11]. The private sector has also often been uninterested in these projects due to “the significant remediation costs and the limited market values” [12]. Meanwhile, “the support of public actors is limited” [13], which has further aggravated the problem of funding in industrial heritage reconstruction and reuse projects.

It has happened that some private investors realized that industrial heritage reconstruction and reuse was profitable and thus invested in it, hence solving the financial obstacle encountered in the process of reconstruction and reuse. However, the short-sighted economic vision of private investors has generally pushed industrial heritage into the abyss, and the conflict of interest between the protection of heritage value and the realization of economic profits has been prevalent [14]. As Cristina Merciu, et al., pointed out, “some of the existing buildings of industrial heritage (special architecture, machinery and working tools of an outstanding value) entered a process with actions based on interests of economic gain. Interventions of brutal functional conversion affected a part of the industrial heritage, with buildings being partially or totally demolished or even being torched”. This comment emerged in the context of the privatization process initiated in Romania in the 1990s, which led to the “capitalization of industrial heritage”. When industrial buildings are bought by investors who often have different development aims, there is a “natural barrier” against the intervention of protective measures [13]. Due to the different degrees of capital intervention, a discourse based on power emerged, and industrial heritage became dependent on capitalist profit-seeking. The original purpose of industrial heritage reconstruction and reuse has tended to deteriorate, and protection has ceased to be a prerequisite for intervention.

2.2. Incomplete Legal System

The capitalization of Romania’s industrial heritage has damaged its heritage value through the reuse process, which has also highlighted the existing problems of this heritage’s protection and management system. Merciu, et al., stated that “the indifference of public administration and the bureaucratic burden related to obtaining the required approvals for the functional changes imposed by conversions and the documentation for the classification of industrial buildings as historical monuments” has had a negative impact on a process of industrial heritage reconstruction and reuse that has aimed at pro-

moting urban renewal; hence, when planning economic policies for local, regional and national development, the protection of industrial heritage should be one of the policy objectives [13]. In fact, not only in Romania but also globally, industrial heritage protection and management have emerged as new concepts, presenting deficiencies in relatively all aspects, especially in industrial heritage reconstruction and reuse, which has become a consensual issue. Therefore, many researchers have emphasized relevant systems of industrial heritage reconstruction and reuse. Meng Fanlei and Qi Chaojie showed that industrial heritage reconstruction and reuse is inseparable from urban development and that targeted policies need to be provided at the urban level to avoid imitation and the sameness of reuse models among cities [18]. Katarzyna Sadowy and Adam Lisiecki also stressed the need for new municipal policies to better respond to grass-roots activities and socioeconomic potential in the regions at stake when studying the reconstruction and reuse of the Warsaw industrial zone [19]. Bartłomiej Sroka showed that in the revival of industrial brownfields, in spite of permanent vertical and horizontal agreements among entrepreneurs, the lack of sectoral policies may lead to the disintegration of the local economic structure [20]. The legal system has been important for industrial heritage reconstruction and reuse. No matter who the actors involved in the implementation of an industrial heritage project are, what the protection level is, and what kind of planning system and institutional environment that project is placed in [21], the legal system is essential. Moreover, researchers have not theorized on this topic enough. Therefore, Gao Xiangguan and Chang Jiang noted that research on laws, regulations, and policies needs to be strengthened in the future to provide a scientific basis for decision-making and a mechanism for the management of industrial heritage reconstruction and reuse [22].

Moreover, financial and system barriers do not only affect the early phases of reconstruction and reuse, but also influence the removal or retention of projects after reuse. For example, María Teresa Palomares Figueres, et al., showed that a reconstruction and reuse project similar to that in the La Sang community (a project that won the Spanish Fostering Arts and Design Awards in 1999) has improved the quality of life of residents. Nevertheless, “a mix of political and economical issues truncated or set aside important ongoing projects” [23]. In this regard, finance and systems have always been important factors affecting the life cycle of industrial heritage reconstruction and reuse projects.

2.3. Secondary Problems

Industrial heritage reconstruction and reuse has not always produced economic, social, environmental, cultural and other benefits. In the case of the increasingly widespread reconstruction and reuse of industrial heritage, a paradox has become increasingly prominent about the benefits of such projects. Researchers have focused on this phenomenon and put forward three warnings. First, we should be alert to the problem of “hollowing out” and “nihilization” of heritage. In the process of industrial heritage reconstruction and reuse, removing machines and their components [26] or failing to reflect the history and value of plants (including buildings) [27] will affect the value and authenticity of industrial heritage. As a result, reconstruction and reuse projects have a “shell” but no “core”, which is not only contrary to the original intention of industrial heritage reconstruction and reuse that aims to protect industrial heritage but also causes the project to face the risk of quickly becoming outdated [28].

Second, we should be alert to the consequences of “densification” in the context of the demographic explosion. Merciu, et al., showed that although industrial heritage reconstruction and reuse can produce significant economic and social benefits, “urban regeneration may result in some negative environmental impacts as well, in relation to the quality of the urban fabric and the natural environment, due to the anthropogenic pressure generated by increased attractiveness of urban space after renovation of the industrial heritage” [13]. Carmen Adams also showed that “the paradox of rehabilitation actions is also highlighted, such as the case of Cabo de Gata, where reuse can lead to environmental deterioration, despite the patrimonial recovery that in principle it entails”. In this regard,

this study emphasized that people involved in industrial heritage reconstruction and reuse should consider the tolerance threshold and the load capacity of the surrounding space, as well as the intended visual improvement of the architectural complex [29].

Third, we should be aware of the negative effects of “gentrification”. Gentrification is a phenomenon that has been abundantly debated. From an economic perspective, gentrification represents the positive external effects brought by industrial heritage reconstruction and reuse [13], which promotes regional “fashionable” and “high-quality” development. However, from a social perspective, gentrification causes “undesirable” residents to be expelled from their original residences and living spaces. Graham Squires and Norman Hutchison revealed this phenomenon by showing that the new housing, whose price exceeds the economic capacity of most community members, excludes people from less privileged social classes [30]. Abigail Wincott, et al., advanced similar views. They showed that the concept of “community” is simplified due to the intervention of more influential and powerful social classes in the process of industrial heritage reconstruction and reuse. The “disturbing” cultural history and its related intangible heritage are marginalized due to its “dark” nature, and new and more benign stories are remembered and promoted. This obliteration of local culture leads to a situation in which “while landowners and developers reap the financial benefits of this transformational process, it has been widely observed that this is often—usually—at the expense of the local communities that are marginalised or displaced” [31]. This marginalization is not conducive to shaping regional identity [32]. Vanessa Mathews analyzed and studied the gentrification of the Regina warehouse area in Saskatchewan by interviewing aborigines, representatives of local businesses and key stakeholders [33]; Renaud Goyer focused on the “gentrification” of the industrial heritage reconstruction and reuse project in Trois-Rivières, Québec [34]. Scholars have focused more on the negative effects of gentrification than its positive effects.

3. Coping Strategies for Industrial Heritage Reconstruction and Reuse

The emergence of successful industrial heritage reconstruction and reuse projects has always been based on some basic principles. Therefore, among studies on industrial heritage reconstruction and reuse of the past five years, many have focused on case studies to unveil people’s experience and promote future industrial heritage reconstruction and reuse projects. Specifically, these studies have highlighted the strategies used in these projects by focusing on three aspects. The main relevant studies are summarized in Table 2.

3.1. Multisubject Participation

In the process of industrial heritage reconstruction and reuse, a wide range of stakeholders are involved, and they have different interests and positions that affect decision-making on specific projects [79] and directly impact that process [57]. Therefore, some researchers have focused on multisubject participation in the early days of research on industrial heritage reconstruction and reuse. In the past five years, an increasing number of researchers have valued multisubject participation, and the scope of their research has gradually expanded to include aspects that had been ignored by early researchers, such as old factory workers and experts. At the same time, compared with the early research on this topic, research conducted over the past five years has refined and deepened it, achieving compelling results. This research has covered four actors: the public sector, private institutions, the public, and experts. Based on different cases and perspectives, different researchers have discussed the importance and responsibilities of relevant actors in industrial heritage reconstruction and reuse.

Table 2. Main literature on the coping strategies for industrial heritage reconstruction and reuse.

Coping Strategies		Author
Multisubject participation	Public sector	Merciu, C., et al., 2017 [13]; Han, H., 2021 [15]; Sadowy, K., and Lisiecki, A., 2019 [19]; Vecchio, M., and Arku, G., 2020 [24]; Fageir, M., et al., 2021 [36]; Subin, X., and Fei, P., 2017 [37]; Bäing, A. S., and Wong, C., 2018 [38]; Subin, X., 2021 [39]; Haiyong, S., 2019 [40]; Trifa, R. M., 2018 [41];
	Private institutions	Fageir, M., et al., 2021 [36]; Rojas, L., 2020 [42]; Bosák, V., et al., 2018 [43];
	Public	Trifa, R. M., 2018 [41]; Shuting, S., et al., 2022 [44]; Wicke, C., et al., 2018 [45]; Mastalerz, A., 2019 [46]; Abuzayed, A. E., and Al-Kurdi, N., 2019 [47]; Lehigh, G. R., et al., 2020 [48]; Ifko, S., 2018 [49]; Yan, Z., 2017 [50]; Ingaramo, R., et al., 2022 [51]; Gilbertová, M., 2017 [52]; Ionica, A., et al., 2020 [53];
	Experts	Hettema, J., and Egberts, L., 2020 [54]; Pânzaru, M. D. R., et al., 2020 [55]; Oevermann, H., and Mieg, H. A., 2017 [56];
Focusing on the integrity of industrial heritage	Tangible heritage	Subin, X., 2021 [39]; Ingaramo, R., et al., 2022 [51]; Yoko, O., 2021 [57]; Jiandong, Z., 2020 [58]; Subin, X., et al., 2022 [59]; Psarri, O., 2022 [60]; Tsilika, E., and Vardopoulos, I., 2022 [61];
	Intangible heritage	Subin, X., and Fei, P., 2017 [37]; Rojas, L., 2020 [42]; Psarri, O., 2022 [60]; Zhike, A., 2019 [62]; Xuejiao, L., and Jiasheng, G., 2021 [63]; Konior, A., and Pokojaska, W., 2020 [64]; Nikolić, M., et al., 2020 [65]; Zhengdong, L., 2022 [66]; Beeston, E., 2020 [67]; Bottero, M., et al., 2019 [68]; Kapp, P. H., 2019 [69];
Selecting the best reuse method	Infrastructure	Fanlei, M., and Chaojie, Q., 2020 [18]; Gyurkovich, M., and Gyurkovich, J., 2021 [25]; Radziszewska-Zielina, E., et al., 2022 [35]; Konior, A., and Pokojaska, W., 2020 [64]; Subin, X., and Nobuo, A., 2019 [70]; Darchen, S., and Poitras, C., 2020 [71]; Glumac, B., and Islam, N., 2020 [72]; Hoekstra, M. S., 2020 [73]; Gyurkovich, M., et al., 2021 [74];
	Theoretical guidance framework	Bottero, M., et al., 2019 [68]; Claver, J., et al., 2018 [75]; Vizzarri, C., et al., 2021 [76]; De Gregorio, S., et al., 2020 [77]; Giuliani, F., et al., 2018 [78];

First, regarding the public sector, Mohamed Fageir, et al., showed that “it is important to uphold the role of the public sector” [36] in the process of industrial heritage reconstruction and reuse, because it controls the development of industrial heritage reuse [37] and has been shown to contribute important financial and policy support. On the one hand, the public sector is not only a major financial supporter but can also attract private investment because it is credible. Andreas Schulze Bäing and Cecilia Wong showed that the central government and the European Community were the main driving forces behind the reuse of the Media City UK project, which subsequently attracted private investment [38]. Han Han also stressed that the public sector could raise the funds necessary for the reuse of industrial heritage in the form of government guarantees through the issuance of special bonds for cultural industries and other channels [15]. On the other hand, the public sector can provide support for policies. While playing an incentivizing and driving role, the public sector can also mitigate the increase in costs and risks usually associated with such reuse activities [24]. For example, institutions of the public sector can support these activities by charging lower fees on applications for changes in land use and distributing the future income according to the stipulations specified in the contracts, turning undeveloped land into developed land and attracting investment more easily [39]. In addition, social forces can be included in such projects through policies, and the public can increasingly supervise the operation and implementation of the projects, which can reduce the occurrence of mistakes in the decision-making of the public sector [40].

Generally, private institutions contrast conceptually with the public sector and include companies, associations, and even individuals that have some capacity (including legal persons). Luc Rojas showed that factories have been widely reused by these actors since the early 1980s in France, which have been present in 63% of such projects [42]. Hence, private

institutions have played an increasingly important role in industrial heritage reconstruction and reuse due to their flexibility and financial resources. Some researchers have even contended that the future of reuse “will be predominantly led by the private sector” [36]. Even so, researchers have also supported the view that the public sector needs to play a leading role in reconstruction and reuse projects [36,43].

The public refers to a group of people who have been connected with the Industrial heritage at stake in the past or directly affected by reconstruction and reuse projects; these people mainly include residents (communities) and prior factory workers. Much contemporary research has focused on the reconstruction and reuse of industrial heritage by focusing on the industrial heritage itself and ignoring the living conditions of industrial heritage communities that have been closely related to the reuse of industrial heritage [44]. Meanwhile, in many heritage sites, nonspatial forms of identity, which are based on class, religion, ethnicity, race, gender and culture, have been interlinked with spatial forms of identity [45]. The public is key in industrial heritage reconstruction and reuse. Therefore, in the past five years, many researchers have focused on this topic and emphasized the importance of incorporating the opinions of residents (communities) and prior factory workers into the different facets of industrial heritage reconstruction and reuse projects through case studies and survey interviews. Indeed, scholars have held that “local community wellbeing is one of the key factors in these renewal schemes” [46]; or, the participation of local communities in the decision-making process can ensure the success of entire operations [41,47,48]; or, heritage is “enabled by people, their work, and engagement” [49] and it is important to conduct research on people and record oral histories [50] to protect this heritage. In addition, a few researchers have focused on the relationship between the public and other entities. For example, Roberta Ingaramo, et al., showed that a solid participation by the community is a prerequisite for the reconstruction and reuse of former productive industrial buildings. Enhancing the public interest in these regions and attracting investors has been an important principle and strategy used to promote reconstruction and reuse [51]. Marie Gilbertová showed that “some of the projects that sparked the public’s interest in the city’s industrial history which, in turn, prompted city officials to take action to safeguard it” [52].

Experts include researchers, architects, planners and designers; they are important because they control the cultural, economic, social and aesthetic effects of industrial heritage reconstruction and reuse projects. Therefore, many researchers have asserted that “heritage professionals proved to have a great say, in the early stages of the adaptation process, in which the adaptive reuse approach was chosen” [54] and that “experts are key stakeholders that initiate and support the implementation of the regeneration projects” [55]. At the same time, because industrial heritage reconstruction and reuse is complex and requires professionalism, more stringent requirements have been proposed for the work of experts in practice. Therefore, some researchers have shown that not only do experts need a solid professional knowledge, but that professional cooperation is also needed [56].

3.2. Focusing on the Integrity of Industrial Heritage

The principle of industrial heritage integrity and research on industrial heritage go hand in hand. As early as 1998, Marilyn Palmer and Peter Neaverson wrote in *Industrial Archaeology: Principles and Practice* that integrity has become a key criterion in industrial heritage. In the research on industrial heritage reconstruction and reuse of the past five years, most researchers have mainly emphasized two aspects, one of which is the integrity of tangible industrial heritage, which mainly refers to the integrity of buildings and the preservation of machinery and equipment. In most of this research, integrity does not need to be intact but needs to be combined with a specific analysis of heritage value characteristics, preservation status, utilization conditions, etc. For example, Zheng Jiandong focused on cultural relics in industrial heritage and showed that the reuse of such buildings should be carried out without affecting the historical and cultural value of the building, the overall layout, and the main structure [58]. At the same time, integrity

has not been limited to single buildings or single industrial heritage sites, as it has also pertained to industrial heritage areas and communities in the surrounding environment. Oyabu Yoko showed that if industrial factors other than machinery, sound and buildings are considered in reconstruction and reuse, the charm of these heritage sites would be highlighted [57]. Zhang Song further showed that, aside from the systematic protection of the integrity of industrial buildings, sites and machinery, it is also necessary to rescue and protect the living heritage related to industrial production, such as workers' new villages, factories' front areas, and supporting service sites and facilities [59]. In addition, Wang Lin also asserted that industrial heritage reconstruction and reuse projects should also consider the style and features of industrial neighborhoods [59]. The living heritage and the neighborhoods together constitute the living environment of industrial heritage, which reflects the characteristics of this heritage and conveys culture [39].

"Keeping and reusing as much of the existing buildings and facilities as possible" [51], has been recognized by an increasing number of researchers as one of the strategies to promote the reconstruction and reuse of industrial heritage.

Scholars engaged in this strategy have emphasized the integrity of intangible industrial heritage, mainly by discussing the significance of heritage and the integrity of historical narratives. The issue of the integrity of intangible industrial heritage has received unprecedented attention in the past five years. Generally, intangible industrial heritage refers to industrial historical archives, technological processes, industrial literature and art related to past industrial production process [80]; this type of heritage constitutes industrial heritage, as the tangible industrial heritage does. Globally, there has been a general tendency to value historical buildings and despise industrial production processes, machinery and equipment in the protection of industrial heritage; this attitude has led to the intangible industrial heritage being neglected in the process of industrial heritage reconstruction and reuse. Some scholars have even held the limited view that reconstruction and reuse can only occur in the case of buildings and structures and that there is no connection with intangible industrial heritage. In fact, the intangible part of industrial heritage also has reuse value [37].

Many researchers have corrected this misunderstanding. Ai Zhike showed that the protection of industrial heritage through reconstruction and reuse cannot limit itself to the planning and design of tangible heritage and that the industrial memory of both tangible and intangible heritage should be fully reflected [62]. Liu Xuejiao, et al., considered intangible industrial heritage when defining the concept of industrial heritage reconstruction and reuse and showed that the concept constitutes a resource in the process of renewing original industrial resources such as buildings, structures, land and intangible heritage that are no longer adapted to the current urban construction [63]. Therefore, intangible industrial heritage cannot be ignored in reconstruction and reuse because the degradation of cities caused by deindustrialization not only occurs "in the spatial sense (many empty postindustrial spaces), but also in the social and the economic sense (unemployment, crime, problems with the adaptation to the new, capitalistic reality)". Hence, the use of heritage for revitalization relates "not only to material aspects (tangible heritage/spatial revitalization) but also to immaterial (intangible heritage/social revitalization)" [64]. In studying revitalization, some researchers have shown that the elements of intangible heritage can be embodied "through various workshops, artistic and educational events which would revive old crafts, customs and the like, and bring them closer to the citizens—the future users of this space" [65].

Intangible industrial heritage not only constructs the environment and highlights the significance of tangible industrial heritage but also makes the latter become more valuable in itself. Therefore, this heritage should be considered in the reconstruction and reuse process. Florence Hachez-Leroy mentioned that the successful integration of dimensions other than architecture, such as economic and social history and technological history, can be meaningful [42].

In addition, when studying the practice of reconstruction and reuse, most researchers have also focused on the fact that industrial heritage has been approached from one perspective and an improper historical narration. Professor Stefan Berger, a famous European social historian and industrial heritage expert, argued that the stories of industrialization in many countries and regions in the southern hemisphere are often linked with colonialism, imperialism, and forms of violence, which may lead to the history of industrialization being forgotten, excluded or suppressed [66]. This exclusion has been the result of improper historical narratives involving intangible industrial heritage. Erin Beeston analyzed the historical narrative emanating from the Manchester Road Station of the Liverpool Manchester Railway in the process of reconstruction and reuse. This site was preserved and transformed into a science and industry museum in the early 1980s. It has made great contributions to the preservation of local and national collective memory and has been known as “the oldest extant passenger railway station in the world”. Therefore, the museum has neglected other significant stories pertaining to this space of industrial heritage, such as its long history of freight transport; in fact, freight went through the station for a longer time than passengers did, but the museum has focused on passengers. In this regard, Beeston stated that “how commemoration embedded at industrial heritage sites can limit our understanding of their past” and that when a museum correctly unfolds a complete narrative about a site, it promotes the role that local narratives can play in the process of industrial heritage protection [67].

3.3. *Selecting the Best Reuse Method*

At present, industrial heritage reconstruction and reuse can fulfill multiple cultural purposes. Museums, exhibition centers, art studios, cultural and creative industries, commercial spaces, etc., have become the most popular ways to practically engage in reuse. In China, the proportion of reconstruction and reuse projects using these avenues is as high as 80.57% [70]. In recent years, with the increasingly close relationship between industrial heritage reconstruction and reuse and urban development, “it is necessary to think about what will best meet the needs of the local community in the long term” [64]. Therefore, an increasing number of researchers have stated that the transformation of industrial heritage into infrastructure should receive more attention and that residential projects are representative of this effort. Many researchers have emphasized the role of residential projects in the revitalization of industrial zones [25,35,71,72]. On the one hand, “profit and the desire to purchase land in a suitable location at a low price was the most significantly motivating factor that affected the decision to engage in a project in a post-industrial area” [35]. The relatively low purchase price of abandoned industrial land has been attractive to real estate agents, which makes it easier to ensure the implementation of reconstruction and reuse projects. On the other hand, the relatively low rental price has made it easier for the affordable housing provided by residential projects to be favored by the market. Brano Glumac and Nizamul Islam surveyed 220 respondents of different ages and familial background and found that “nearly 70% of respondents favored renting a unit in an adapted building” [72].

Infrastructure reconstruction and reuse projects such as residential projects are more inclusive because they are oriented to solving social problems, thus maximizing the balance between supply and demand, gathering popularity and controlling the gentrification of industrial heritage spaces [40]. Compared with the urban regeneration strategy along which local governments use cultural brands and landmark buildings to build cities into tourist destinations and places that attract capital investment, the latter can easily fall into the trap of elite projects [73] or into situations in which no one cares because these projects are out of touch with the local sense of place and the daily reality of residents who experienced the “industrial destruction”; hence, the comprehensive benefits of these projects hardly exceed those of infrastructure projects. In this regard, transforming industrial heritage into infrastructure is an effective method both in theory and practice. It is also necessary to be

alert to the problem that industrial heritage reconstruction and reuse will become “real estate” due to excessive reuse in practice [18].

Because industrial heritage reconstruction and reuse constitute complex projects and measures need to be adapted to local conditions to ensure compatibility between reuse methods and industrial heritage status [13], providing a complete set of guiding methods for industrial heritage reconstruction and reuse has become a pressing issue to minimize the uncertainty of the process.

Juan Claver, et al., proposed a method for the development and evaluation of heritage value and to unveil the most compatible use by using the analytic hierarchy process (AHP) [75]. In this process, it is necessary to first determine what is the most important heritage when different heritage items of the same type need to be protected; indeed, it is almost impossible to preserve all heritage. Then, it is necessary to select the most appropriate new use for the heritage at stake according to the results of the evaluation. Corrado Vizzarri, et al., proposed an overall method of evaluation based on appropriate indicators and calibration through the AHP model and combining qualitative and quantitative methods. They analyzed and verified the former site of the Enel Power Plant in Bari, Italy, to enhance the feasibility of the method [76]. Different from Claver, et al., Vizzarri, et al., emphasized the effects of reconstruction and reuse projects in terms of meeting the needs of the population and respecting the landscape, and they chose reconstruction and reuse strategies according to these needs being met. Claver, et al., focused on the evaluation of heritage values. Although these scholars applied AHP, the former’s methodological framework covered the overall process, from choosing the subject of reuse to showing how to reuse it, while the latter focused on one aspect of the overall process and analyzed how to choose appropriate reconstruction and reuse strategies based on that process. Hence, the latter is obviously a step ahead of the former in terms of research depth.

In addition, Marta Bottero, et al., also stated that the optimal reconstruction and reuse strategy could be determined by ranking the preferences of different stakeholders for the reconstruction and reuse strategy of industrial heritage; therefore, they propose a multistandard decision support method [68]. Stefania De Gregorio, et al., were more specific and microcosmic in their study. They propose that reconstruction and reuse should first use the context analysis method to analyze the environment, including the contemporary and historical environment. Then, the architectural analysis method is chosen to analyze the buildings, determine the advantages to be used, and determine the key points to be solved. Finally, the compatibility matrix is used to optimize the data, and the reconstruction and reuse strategy that is consistent with the industrial heritage environment and buildings is selected [77]. These research results have provided certain theoretical guidance for the selection of industrial heritage reconstruction and reuse strategies and for practice.

4. Evaluation of the Effects of Industrial Heritage Reconstruction and Reuse

The evaluation of the effects of industrial heritage reconstruction and reuse not only helps to correct the deficiencies of such projects themselves but also provide a practical reference for future industrial heritage reconstruction and reuse efforts. The evaluation of the effects is certainly important. Therefore, research on the evaluation of the effects of industrial heritage reconstruction and reuse has shown a growing momentum in the past five years. Specifically, in terms of research methods, qualitative evaluation methods have been optimized, and quantitative evaluation methods have been gradually valued and improved. In terms of research targets, the evaluation of individuals has become more prominent than the evaluation of projects. Some important and representative literature on the topic is summarized in Table 3.

Table 3. Main literature on the evaluation of the effects of industrial heritage reconstruction and reuse.

Evaluation Effects		Author
Evaluation method	Qualitative evaluation	de Broekert, C., 2022 [9]; Konior, A., and Pokojaska, W., 2020 [64]; Yan, Q., et al., 2019 [79]; Erlewein, S. N., 2017 [81]; Yoko, N., and Hiroshi, I., 2018 [82];
	Quantitative evaluation	Bäing, A. S., and Wong, C., 2018 [38]; Dell’Anna, F., 2022 [83]; Guiwen, L., et al., 2022 [84]; Qinna, Z., and Hang, L., 2022 [85]; Xinna, W., et al., 2021 [86]; Vardopoulos, I., 2019 [87];
Evaluation target	Individuals such as tourists and residents	Mesda, Y., and Kurt, S., 2021 [88]; Berki, M., 2017 [89]; Martinat, S., et al., 2018 [90]; Kim, E. J., and Miller, P., 2017 [91];

4.1. Qualitative Evaluation Method

Among the results of qualitative studies on the effects of industrial heritage reconstruction and reuse, the “three-pillars approach” has been the main assessment method used to assess these effects from the trifold perspective of economic, social and environmental sustainability. For example, Corné de Broekert applied the “three-pillars approach” to explore the positive impact on the economic, social and environmental sustainability of industrial heritage reconstruction and reuse projects in postindustrial cities in the Netherlands, as well as the factors affecting the degree of added value generated [9]. As research has progressed, many researchers have come to believe that the “three-pillars approach” is insufficient to meet the complex challenges faced by modern society. In addition to economic, social and environmental sustainability, cultural sustainability is also an important dimension. As Sotiria Sarri’s research demonstrated, cultural sustainability is a way to maintain cultural diversity and help build inclusive societies and strengthen economies [92]. In practice, an increasing number of governmental and nongovernmental organizations have used culture as a tool for accelerating economic growth, promoting social cohesion, stability and human welfare, and solving environmental problems [93]. Therefore, some researchers have proposed the “four-pillars approach” to meet the requirements of sustainable development. The “four-pillars approach” extends the evaluation to include culture and emphasizes that the cultural dimension is “integrated on an equal basis with the other three dimensions. This approach highlights culture as (re)source and considers components of culture to include heritage, identity, memory, creativity, human knowledge and skills, cultural practices, lifestyles, value systems and diversity, among others” [81].

In addition, some researchers have focused on specific aspects of industrial heritage reconstruction and reuse projects for their evaluation. For example, Nakai Yoko and Ito Hiroshi evaluated the effects of the reconstruction and reuse of the Kiryu sawtooth roof factory from the perspective of the protection of regional characteristics and local industries; they determined evaluation criteria according to the historical and industrial characteristics of Kiryu, including whether the textile factory was located in an area facing the river, whether the three facilities (sawtooth roof factory, residence and warehouse) still existed in one place, whether the space had remained vacant, and whether textile products were still being used. Highlighting regional characteristics was at the core of their evaluation of the effects of industrial heritage reconstruction and reuse [82]. Compared with the “three (four)-pillars approach”, the results of an evaluation that focuses on one aspect are undoubtedly more targeted. Nevertheless, there were also shortcomings in this study because important dimensions were omitted, resulting in the “disconnection” between the actual effects of the project and the effects that could be achieved in theory.

4.2. Quantitative Evaluation Method

To solve the problem of how to precisely quantify externalities caused by reconstruction and reuse projects, many researchers have focused on research pertaining to quantitative evaluation methods in recent years. On the basis of the “three-pillars approach”, Qian Yan, et al., introduced a weighted index in relation to stakeholder demands

and built a sustainability indicator system for industrial heritage reuse that includes social, economic and environmental dimensions to quantitatively evaluate the social, economic and environmental benefits of industrial heritage reconstruction and reuse projects [79]. Federico Dell'Anna estimated the economic impact of the reconstruction and reuse project implemented in the Turin's Aurora district (Northern Italy) and focused on the real estate market in the surrounding areas in recent years using an econometric model [83]. Similarly, Liu Guiwen [84], Zhao Qinna [85], Wei Xinna [86], etc., discussed the impact of industrial heritage reconstruction and reuse projects on surrounding housing prices. The research of Liu Guiwen and Zhao Qinna focused on one case or a group of cases. By using different analytical models, they concluded that reconstruction and reuse projects had a significant effect on the price of surrounding housing. Wei Xinna further explored the impact of different types of reconstruction and reuse projects on housing prices in the surrounding areas and concluded that reconstruction and reuse projects that are oriented toward commercial and cultural facilities can relatively improve housing prices in the region. In addition, Bäng and Wong used data analysis to assess the impact of the reconstruction and reuse project of Salford Quays in England on the community [38]. Ioannis Vardopoulos used the DEMATEL model to find out what elements of reconstruction and reuse projects can promote local sustainable development. He also evaluated the pattern and extent of interaction between these different factors [87]. Hence, it is predictable that quantitative evaluation methods have been prominent in this field.

4.3. Individuals as Main Evaluation Target

The results of the research conducted in the past five years on industrial heritage reconstruction and reuse have shown that individuals have become the main targets of the evaluation of the effects of these heritage projects; individual perception has become the main component of these evaluations, which is a shift from previous approaches that focused too much of projects themselves. This shift reflects changes in the concept of industrial heritage reconstruction and reuse. In the past, industrial heritage reconstruction and reuse were carried out as a way to protect heritage; nowadays, the main goal has become to promote social development and meet social needs via protection.

Based on the phenomenological method, Yasemin Mesda and Sevinc Kurt studied the spatial experience of individuals in the Nicosia Municipal Arts Centre, a museum that emerged out of the transformation of industrial architectural heritage in Cyprus. Through multisensory analysis, these scholars grasped the emotions and attitudes of individuals in that space to evaluate the effects of reconstruction and reuse [88]. Márton Berki also focused on the experience of individuals in the reused space. He focused on groups such as tourists. Through questionnaires, he studied how tourists understood and approached the venue and the ways in which they used the venue to assess the success of the reconstruction and reuse project [89]. Stanislav Martinat, et al., not only focused on tourists but also on how residents perceived a series of industrial brown land reuse projects, and they summarized people's experience in industrial heritage reconstruction and reuse projects [90]. Eujin Julia Kim and Patrick Miller also focused on residents' perception of industrial brownfields after reconstruction and reuse [91]. Hence, individuals' subjective experience has become an important starting point for most researchers to evaluate the effects of industrial heritage reconstruction and reuse projects, and tourists and residents have become important targets for researchers.

5. Conclusions

In the past five years, industrial heritage reconstruction and reuse has become a key issue in the field of international heritage protection. Research topics have been gradually refined and focused, and researchers have innovated in their research methods and perspectives, which have been integrated to varying degrees. Through the analysis of studies published in the field over the past five years, the current research on industrial

heritage reconstruction and reuse still needs to be improved and strengthened; these shortcomings can serve future researchers to develop new directions in this field.

5.1. Research Perspectives

First, future research should focus on three major topics. They should establish a definition of industrial heritage reconstruction and reuse. The existing research has shown that the academic community has not yet reached a consensus on the concept of industrial heritage reconstruction and reuse. The phenomenon of “misuse” and “mixed use” has recurrently emerged, leading to scattered studies on the topics, which are difficult to bring together and systematize; hence, it has been difficult to move forward in the field of industrial heritage reconstruction and reuse. It is necessary for scholars to join forces to accelerate the integration of the concept of industrial heritage reconstruction and reuse and promote new research in the field.

Second, the COVID-19 epidemic has caused a crisis in industrial heritage reconstruction and reuse projects. The negative impact of COVID-19 on the global economy has been obvious to all. Policies aiming at reducing the size of urban agglomerations have also increased the difficulty facing reconstruction and reuse projects that rely on offline activities. As a result, it has become common for most industrial heritage sites to be forced into a state of “secondary ruins”. Therefore, researchers should focus on COVID-19 as a current obstacle. Researchers should apply themselves to propose feasible strategies for solving the problems brought about by COVID-19; they should consider the pandemic when evaluating the effects of industrial heritage reconstruction and reuse projects for their studies to be more scientific and accurate. Obviously, an exploration into the relevant literature reveals that this issue has been ignored. Only a few studies have mentioned COVID-19, let alone proposed strategies to help industrial heritage reconstruction and reuse projects cope with the consequences of the epidemic.

Third, industrial heritage reconstruction and reuse has created a turnaround in rural revitalization. By analyzing and sorting out the relevant literature of the past five years, we found that most researchers have considered how industrial heritage reconstruction and reuse can promote urban regeneration and urban sustainable development and paid less attention to the role of these projects in promoting rural development. The conservation and reuse of rural heritage has become an important issue in global rural studies [94]. As a form of rural heritage, rural industrial heritage constitutes a unique cultural symbol of the countryside, it is particularly evident in Asian latecomer countries represented by China, Thailand, and Vietnam. It needs to be considered in research and promoted in practice.

On the other hand, future research should strengthen the application of two methods. First, comparative methods should be promoted. At present, most researchers have selected only a single reconstruction and reuse project as their case study, and they have even selected a single project in their verification and analysis when proposing a set of overall frameworks for the selection of industrial heritage reconstruction and reuse strategies. The problems addressed and coping strategies proposed in these studies are targeted toward specific projects, but are often not universally applicable, which affects the value of the research. The introduction of comparative analysis principles is useful to make these studies as comprehensive and thoughtful as possible, so they include all the details of a single project and enhance the persuasiveness and feasibility of the research results.

The second approach is the dynamic research method, which is particularly useful to evaluate the effects of industrial heritage reconstruction and reuse projects. Most researchers have used tourists’ perceptions and experiences as references when evaluating the effects of industrial heritage reconstruction and reuse projects. However, tourists represent an unstable group, as time, weather, personality and other factors affect how many tourists there are and their experiences, which in turn affect the authoritativeness and credibility of the evaluation results. The introduction of a dynamic research method requires researchers to monitor their targets for a period of time to eliminate as best they can the contingencies caused by other factors.

5.2. Limitations

First, in this paper, we addressed the global trend in the research on industrial heritage reconstruction and reuse. The literature on this topic is voluminous and complex due to the continually increasing attention paid to industrial heritage reconstruction and reuse in recent years. The literature review here may not be comprehensive, although the important studies on the topic have certainly been included to ensure that our overall results are scientifically accurate. Moreover, due to the limitation of the length of this paper, only the most representative studies (those published in key journals in the field) or the most influential studies (those highly cited) are cited. We present the authors' perspectives rather than their papers themselves; it is thus impossible for us to list the 404 studies individually in this paper. Second, we may have been mistaken in the way we read and understood studies written in different languages, as we have been unable to master these languages. Nevertheless, we have consulted experts in the relevant languages to minimize the potential bias in the way we summarized the views of other researchers. Our research has some limitations, but we have attempted to overcome them to ensure the integrity and comprehensiveness of the summary information provided and the credibility of our research conclusions.

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