A study on the post-evaluation system of functional upgrading and transformation for old urban industrial areas

X Y Yue1*, H Y Pan1, P Tang1, H Sun1 and Y An1

1Shanghai Research Institute of Building Science Co., Ltd, Shanghai, 201108
*yuexiaoyang@sribs.com, yang_sribs@163.com

Abstract. At the beginning of the 21st century, China began to transform and upgrade the old urban industrial areas. At present, it is relatively lack to research the post-evaluation system of functional upgrading and transformation for old urban industrial areas. This paper chooses and analyzes 24 typical projects of regeneration and transformation for old urban industrial areas through literature research. On the basis of analyzing the relevant literature research, policy implementation and practice results of typical projects, this paper proposes a post-evaluation system with comprehensive influence as the target and 5 influence dimensions and 21 evaluation factors through combining qualitative and quantitative techniques. Based on this, the connotation of evaluation factors is analyzed, so as to form a practical post-evaluation system of comprehensive influence.

1. Introduction

Along with the rise and the rapid development of post-industrial era, more and more old industrial regions in China are gradually facing problems such as unreasonable industrial structure, weak innovation ability, ecological environment destruction and lack of green development power[1]. In order to solve above problems, China started transformation and upgrading of old urban industrial areas in the early 2010s, and now many old industrial areas are undergoing large-scale renovation and transformation. Through sorting out the development of renewal process of old urban industrial regions in China, it is found that the research on the renewal and transformation of the old urban industrial regions mainly focuses on renewal mode, transformation strategy, planning and design methods. The characteristics of different renewal modes of old urban industrial areas are summarized, and the index system and evaluation method for the renewal modes of industrial areas are put forward in Yin’s research[2]. Agueda BF analyzed the impact of different transformation strategies on urban renewal from four aspects: transportation, industrial culture and working memory, local economic development conditions, and residential site selection[3]. Through the research and analysis the planning and reconstruction cases of old industrial zones at home and abroad, Zhou analyzed and summarized the planning and reconstruction methods of old industrial zones from aspects of industry, society, culture, landscape, ecology and history[4].

However, there is still a lack of complete research system and evaluation method for the post-evaluation of existing urban industrial areas, and a lack of comprehensive performance evaluation in cultural, ecological, vitality, operation and other aspects for industrial areas after functional upgrading and transformation. Therefore, it is extremely necessary to carry out research on the functional upgrading and transformation post-evaluation of existing urban industrial areas, to meet the actual needs of post-evaluation, and to promote the sustainable development of urban renewal. This paper will adopt the mode of "case analysis - connotation research - system construction" to carry out
the research on the post-evaluation system for the old urban industrial areas, and explore a set of evaluation system with certain practical guiding significance.

2. Basic case study analysis

Based on CNKI, Wan Fang data and WOS as the foundation of scientific research literature retrieval database, and with "post-evaluation", "old industrial zone" and "renewal and transformation" as the key words, the relevant research literature was searched. Combined with the practical investigation of existing industrial regions renovation projects, 24 typical existing urban industrial regions renovation projects are selected from nationwide. Geographically, it covers the first and second cities in northeast China, north China, southeast China, south China, southwest China and other regions, and gathers different industrial, like heavy industrial zones: Shougang Industrial Park in Beijing[5], Taopu Smart City in Shanghai[6], Ruhr industrial base in Germany[7], etc. and light industrial zones: Yuanhe 1916 Creative Industry Park in Fujian[8], Baqiao District textile industry old factory area in Xi’an[9], etc. and commercial residential mixed industrial zones: Yangpu Binjiang in Shanghai, Kowloon Kwun Tong old Industrial zone in Hong Kong[10], etc.

Based on the basic overview of typical projects (including location, urban location and pre-transformation type), the influencing factors and post-transformation type of the industrial zone are further analyzed. The research process and conclusions are shown in Figure 1.

Fig. 1 Analysis results of typical reconstruction projects of existing urban industrial areas

Based on the analysis, the great part of upgrading existing urban industrial zones are located in the central city area (as shown in figure 2). For the city's development needs, service diversification demand, urban industrial structure adjustment factors, etc., the existing industrials located in development area are encouraged to transform and/or removal so as to realize land value enhancement and landscape ecological improvement. Therefore, geographically speaking, the post-evaluation research object is mainly the existing industrial areas located in the central city area or in the areas encouraged for development, which need to be improved and transformed.

In addition, the existing urban industrial areas have been renovated to form various types, and the modified types are classified according to the main functions they provide. It can be divided into urban public function (cultural and creative park), industrial transformation and upgrading (the original industrial technology promotion and/or transformation), urban live function (live mainly mixed business), sustainable ecological restoration (city park and green space). Among them, the number of cultural and creative parks is the largest, followed by industrial transformation and upgrading and mixed-use commercial and residential areas. The number of city parks and green spaces is relatively small (figure 3). Therefore, the post-evaluation research objects of the existing urban industrial areas are mainly the above four types.
3. Post-evaluation connotation research

3.1. Research object
Based on the analysis of basic situation of typical projects, the research object of post-evaluation is determined, as shown in figure 4.

3.2. Research direction
The factors that promote or influence the functional upgrading and transformation of an existing urban industrial area are not only ones. Through the research and analysis of the 798 ArtDist in Beijing, it is concluded that the development planning of Beijing urban area and the reorganization and adjustment of plant assets are the important factors that cause the original plant to be idle, and the characteristic style of Baohaus architecture and the holding of "International art Festival" are the main driving forces to promote the development of this area to form a creative and fashionable art district[11]. In the research and analysis of the renovation projects of Shanghai Taopu Smart City, Yangpu Binjiang and other old industrial areas, it is found that in the renovation process, there are complex and continuous influencing factors such as regional traffic accessibility, public service convenience, sustainable resource utilization, and operation and management strategies, etc.[11]. Therefore, the performance evaluation of the existing urban industrial areas during operation period after reconstruction should comprehensively consider the continuous influence of the driving factors before reconstruction, the influencing factors in all aspects during reconstruction period, and the influence on the surrounding environment or regional development during operation period.

Based on the mechanism analysis of the influencing factors for existing urban industrial areas, the research direction of post-evaluation is drawn: the protection and utilization of industrial heritage, the green transformation of functional buildings, the ecological creation of site environment, the overall creation of regional vitality and the sustainable development of operation and management. As shown in figure 5.
4. Post-evaluation establishment

Based on certain research object and direction of post-evaluation, we researched and analysed the existing green building evaluation standard, green ecological communities and cities evaluation standard and some theoretical system related to the existing urban industrial area functional upgrading and transformation. And then based on the principles of comprehensiveness, suitability, scientific and distinctiveness, 21 post-evaluation factors were selected according to their relevance. The comprehensive impact assessment system for functional upgrading and transformation of existing urban industrial areas is built by sort the 21 factors into five dimensions, planning development, operation management, cultural continuation, ecological regeneration and vitality perception[12][13]. Based on the status quo of existing urban industrial regions, this system focuses on the evaluation of heritage protection, industrial transformation, ecological transformation during renovation process, and the vitality atmosphere and management effectiveness in operation periods. It is a comprehensive impact post-evaluation system for the functional upgrading and transformation projects of existing urban industrial zones. As shown in figure 6.

At the same time, considering the operability of the post-evaluation system, each factor at the decision level should be operational and can be quantified through data collection and/or data statistics. Therefore, the connotation of each factor and the main assessment methods are further studied and explained, as shown in table 1.

Table 1 Connotation research and analysis of comprehensive impact assessment factors

| Factor type     | Factor name                   | Factor connotation                                                                 | Evaluation method                                                                 |
|-----------------|-------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Planning        | Economic comprehensive strength | Measure the economic strength and market scale of the area where the industrial zone is located. | Evaluate the current actual GDP growth value of the city/district to see whether it reaches the set annual growth target value. |
| development     | Function                       | The functional positioning of industrial zone is                                   | The actual operation function of the object                                         |
| impact          |                               |                                                                                    |                                                                                  |
| Operational management impact | History value | The industrial historical buildings built in the early period depict the architectural characteristics of the times. |
|--------------------------------|---------------|----------------------------------------------------------------------------------------------------------------|
| Cultural continuance impact    | Culture memorability | The existing urban industrial areas carry rich cultural memories. Protecting these elements are not only protecting the carriers for public's understanding history and culture, but also protect the generations' cultural memories. |
| Cultural and creative enterprises increasing | Landmark measure | As a part of future city, the renewal and transformation of existing urban industrial zone will have a certain influence on the future development of city in terms of cultural propaganda and historical inheritance. |
|                                | Cultural atmosphere satisfaction | The better cultural atmosphere is conducive to improving the aesthetic taste of staff, enriching people cultural life, and enhancing the cultural publicity and influence. |
| Ecological regeneration impact  | Natural environment onsite | The good wind-heat environment on site is conducive to outdoor walking, comfortable activity and natural ventilation of buildings. Stable and reasonable site runoff control is conducive to strengthening ecological environment construction. |
|                                | Sustainable resource utilization | Developing unconventional water resources to improve the utilization rate of water resources recycling; Promote the application of clean energy such as solar and wind. Improve the utilization rate of solid waste resources and reduce the landfill of building materials. |
|                                | Green building proportion | Encourage green renovation of existing buildings, and increase the proportion of green buildings in new buildings to save resources and protect the environment. |
|                                | Phytocen | By improving the soil quality, create a reasonable |
|                                | Matching degree | directly related to the coordinated development of regional industry, intensive land use and improvement of regional economic benefits. |
| Policy implementation          | Promulgating and implementing encouraging policies by governments is conducive to the renovation of industrial areas, which can promote and improve the quality of projects. |
| Operation management model     | Through the formulation of operation policies and regulations, the responsibility system will be improved, and measures should be implemented to form a reasonable management model. |
| Green economic benefit         | Reduce the economical utilization of non-renewable resources, such as energy, water and materials, is equal to reduce economic operation costs. |
| Innovation demonstration project | Creating the innovation demonstration projects can obtain financial support, improve regional visibility, and promote better construction. |
|                                | It mainly investigates the construction time, historical value, heritage value and cultural significance. |
|                                | Investigate the preservation of original industrial buildings, specific industrial cultural elements in renovation process, such as production technology value, labor culture, etc. |
|                                | Pay attention to the major achievements or commemorative innovative measures in renovation process, including culture soft power and facilities hard power. |
|                                | Mainly investigate the types distribution of after-renovation industrial zone, and then evaluate the influence of the cultural innovation. Cultural and creative enterprises include film, animation, performing arts, craft and design, etc [14] |
|                                | A questionnaire on cultural atmosphere satisfaction is designed to assess the public satisfaction from aspects of cultural facilities, activities, public participation, and inheritance. |
|                                | Establishing site model to simulate outdoor wind and thermal environment, analyze the site runoff, optimize the building layout, color of paving materials and layout of sponge facilities, and regional microclimate environment. |
|                                | Evaluate the utilization rate of un-portable water sources, renewable energy and solid waste resources. |
|                                | Investigate the proportion of green buildings in new buildings and the proportion of energy consumption reduction after green renovation of existing buildings. |
|                                | Evaluate the rationality of plant hierarchy |
5. Conclusion and prospect

1) Through studying and analyzing the typical projects related to existing urban industrial areas functional upgrading and transformation, the location distribution of the reconstruction industrial area is clarified, and the classification of project types after-transformation is completed, and the research objects of post-evaluation are determined.

2) Further analyze the mechanism of the influencing factors of existing urban industrial areas functional upgrading and transformation, the improvement direction of the existing urban industrial areas are concluded, and the research direction of post-evaluation includes the protection and utilization of industrial heritage, the green transformation of functional buildings, the ecological creation of site environment, the overall creation of regional vitality and the sustainable development of operation and management.

3) Based on definite post-evaluate research object and direction, A post-evaluation system with comprehensive influence as the target, including 5 influence dimensions and 21 evaluation factors is constructed. Based on the status quo of existing urban industrial regions, this system focuses on the evaluation of heritage protection, industrial transformation, ecological transformation during renovation process, and the vitality atmosphere and management effectiveness in operation periods. It is a comprehensive impact evaluation system for the functional upgrading and transformation projects of existing urban industrial zones.

4) Finally, the connotation of each evaluation factor is explained to provide technical guidance for the follow-up practice and operation of the post-evaluation system. The next step will focus on the demonstration project, and collect the other domestic existing urban industrial area upgrading project information to help apply this comprehensive impact evaluation system in the actual project. This will provide reference and inspiration for the post-evaluation practice of existing urban industrial areas functional upgrading and transformation project.
Acknowledgements
This paper is one of the achievements of the 13th Five-Year National Key R&D Program of China “Research on diagnosis evaluation techniques and planning methods for functional upgrading and reconstruction of existing urban industrial areas” (Foundation Item: No. 2018YFC0704902).

References
[1] Wang, J. G. (2007) The preservation and renewal of industrial architectural heritage in the post-industrial era. China Architecture Publishing, Beijing.
[2] Yin, X. R. (2009) Study on evaluation index system and model building for old industrial district. School of Architecture, Southeast University, 17-61.
[3] Fernandez, A. B. (2014) Urban restructuring in former industrial cities: urban planning strategies. Journal of Geography and Planning, 23: 3-14.
[4] Zhou, L. S. (2015) The research of urban old industrial area renovation. Landscape Architecture, BJFU, 43-50.
[5] Bo, H. T. (2020) Dynamic Update facing stock Era - Urban Renewal practice of Beijing Shougang. Urban and Rural Development, 2: 6-11.
[6] Zhou X. J. (2015) Exploration on renewal planning method of urban old industrial zone based on transformation development. In: Annual national planning conference Guiyang. 461-473.
[7] Xu G. Y. (2006) Research on reconstruction mode of northeast old industrial base. Management science and engineering, Harbin engineering university, 32-138.
[8] Sun, X. L. (2019) Study on renewal and transformation planning strategy of old industrial area in the central city—A case study of Beifeng industrial area in Quanzhou. Fujian. Architecture & Construction, 247: 9-15.
[9] Chen, S. Y. (2010) Old industrial factory space environment, update the design of organic—Case study of Textile city of Xi'an. Urban planning and design, Xi'an University of Architecture and Technology, 58-90.
[10] Liu, S. Q, Wang, J. Y. (2017) Application of overhead design in the transformation of old industrial area in high density Environment -- A case study of Kwun Tong District, Hong Kong. Science and Technology & Innovation, 19: 150-152.
[11] Sepe, M. (2018) Place identity and creative district regeneration: the case of 798 in Beijing and M50 in Shanghai art zones. METU Journal of the Faculty of Architecture, 35: 151-171.
[12] Wang, X. X. (2009) A study on post-occupancy evaluation and POE operate mode for buildings. Urbanism and Architecture, 7: 16-19.
[13] Han, X. (2019) Research on the construction of the heritage evaluation system of Korean traditional villages in Yanbian region. School of architecture and urban plan, Jilin Jianzhu University, 41-70.
[14] Baidu baike (2020) cultural creative industry. https://baike.baidu.com/item/Cultural and Creative Industries/1281697?fr=aladdin.