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# Analysis on Research Trend of Inefficient Industrial Land

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**ABSTRACT**: The extensive utilization and disorderly expansion of industrial land have led to an increasing number of inefficient industrial land. It is of great significance to effectively improve the utilization efficiency of industrial land to promote the high-quality development of China's industry. This paper attempts to discuss the concept connotation, evaluation research, cause analysis and redevelopment of inefficient industrial land, and on this basis, make literature review and prospect. By combing the literature of inefficient industrial land, it can provide reference for the innovative research of inefficient industrial land.

**KEYWORDS:**inefficient industrial land; Concept connotation; Evaluation research; Cause analysis; Re-development and utilization.

## I. INTRODUCTION

Rapid urbanization and industrialization [1-2] continue to stimulate economic growth, but also triggered a series of problems of resource waste and extensive utilization. The extensive expansion of industrial land [3-5] leads to the continuous extension of urban construction land boundaries, the low level of intensive use of land resources [6-8], and the increasing number of inefficient idle land [9-10]. In order to revitalize the inefficient stock of industrial land and realize the high-quality [11-12] redevelopment of industrial land, many experts and scholars at home and abroad have carried out relevant research from various angles around inefficient industrial land. This paper will discuss the concept connotation, evaluation research, cause analysis and redevelopment of inefficient industrial land, and on this basis, review and prospect the literature, in order to provide new perspectives and ideas for the innovative research of inefficient industrial land.

## II. THE CONCEPT OF INEFFICIENT INDUSTRIAL LAND

As far as the current research status is concerned, many experts and scholars have not reached an agreement on the definition of inefficient industrial land. Zeng Yan believes that the connotation of inefficient industrial land mainly includes three aspects: first, industrial land with no location comparative advantage, poor competitiveness and in the stage of life cycle decline; Second, the land for industrial projects such as land investment intensity, land output rate and plot ratio failed to meet the requirements of relevant standards; Third, industrial land that is currently idle, abandoned or abandoned but can be reused through adjustment [13]. Wang Mengdi believes that inefficient industrial land refers to the fact that the currently developed industry is not suitable for the current development stage of the city, or it is widely used although it is suitable for the current development stage of the city, and the spatial value of the land has not been fully manifested [14]. He Fang believes that inefficient industrial land refers to idle land that has gone through land supply procedures, idle land, land that has stopped construction and production, or industrial land that has been used but has low land use intensity, low input-output efficiency, does not conform to industrial development and environmental orientation, does not meet the conditions agreed in the contract or is improperly used [15]. Grace Wai Wong believes that inefficient industrial land refers to industrial land with relatively low development utilization rate, building floor area ratio, input-output ratio and so on, which has had a negative impact on the surrounding ecological environment in the process of development and utilization [16]. Zhang Lan believes that inefficient industrial land refers to the existing construction land such as industrial, mining, warehousing, etc., which do not conform to the industrial policy orientation, fail to

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meet the safety production standards, fail to meet the environmental protection standards, are scattered in layout, are widely used, are unreasonable in use, have low output benefits, and the relevant contracts are not fulfilled as promised [17]. Looking at the above scholars' understanding of the connotation of inefficient industrial land, and referring to the research results of Zhou Lianghua [18] and Chen Jiwei [19], this paper tries to make a preliminary summary of the connotation, characteristics and classification of inefficient industrial land, and the results are shown in Table 1.

**Table 1 The connotation, characteristics and classification of inefficient industrial land are preliminarily summarized.**

| intention | characteristic | classify |
|---|---|---|
| 1、Industrial land that has been developed or used;<br>2、Industrial land that has not been fully utilized and is in an abandoned or idle state;<br>3, does not meet the requirements of environmental protection, safe production of industrial land;<br>4. Industrial land that can be reused through effective governance;<br>5. Industrial land with low current development efficiency and potential for further development. | 1. Low-efficiency land that does not have comparative advantages in location, lacks competitiveness and is in a recession;<br>2, land use, investment intensity, plot ratio, building coefficient, land output rate, the proportion of administrative office and living service facilities, green rate and other industrial land that does not meet the relevant requirements;<br>3、At present, it is idle and abandoned, and there are still industrial land for adjusting the use of space;<br>4、High-risk land with high energy consumption, high pollution and substandard environmental protection and safety index | 1、In the development of cities and towns, there must be land for eliminated and prohibited industries;<br>2、Industrial land with low efficiency, high pollution and high energy consumption does not meet the requirements of national environmental protection and safe production;<br>3、Industrial land with relatively low output efficiency and land use;<br>4、In the process of land construction and utilization, due to some reasons, it suddenly stops, such as enterprise closure, contract breach and so on, which leads to idle industrial land. |

## III. EVALUATION OF INEFFICIENT INDUSTRIAL LAND

Because the connotation of inefficient industrial land has not yet formed a consistent understanding, the evaluation of inefficient industrial land is different from the selection of indicators, methods and scales. Judging from the selection of evaluation indicators, Chen Wei and others describe the utilization efficiency of industrial land mainly from the economic benefits and the average industrial added value of land [20]; Tu Fan and others mainly measure the utilization efficiency of industrial land with floor area ratio and comprehensive building density from the perspective of land development and utilization [21]; Xie Hualin and others comprehensively measured the utilization efficiency of industrial land by selecting labor force, GDP, industrial wastewater and other indicators from social, economic and environmental perspectives [22]; Zhuang Hongwei and others build an evaluation index system from three aspects: land input level, land output level and land structure benefit to comprehensively evaluate the industrial land use efficiency of the development zone [23]; When constructing the evaluation index system of inefficient industrial land in Zhang Lan, it comprehensively evaluates the inefficient industrial land in the development zone and calculates the redevelopment potential from four angles: intensive utilization, land compliance, enterprise development prospects and land structure [17]; Yong Yang follows the three-dimensional standards of social benefit, economic benefit and environmental benefit when constructing the index system of inefficient industrial land, and selects the indicators from four aspects: land use intensity, land use efficiency, land input intensity and land use sustainability [24]. From the evaluation method, Cui Xinlei and others used DEA model and Malmquist index model to evaluate the industrial land use efficiency of resource-based cities [25], and Jiang Haitou used SBM model to evaluate the industrial land use efficiency of prefecture-level cities in the middle reaches of the

Yangtze River in China [26]; When constructing the evaluation model of inefficient land use in industrial parks in Grace Wai Wong, referring to the evaluation index system of land conservation and intensive use in national development zones, 12 indicators were selected from four aspects: land use status, land use benefit, management performance and ecological benefit, and the entropy weight method and the target value method were comprehensively used to evaluate the efficiency of industrial land, so as to determine whether it belongs to inefficient use [16]; Zhang Lin and others used Theil entropy and MLD index to evaluate the efficiency of new industrial land in China as a whole and in the four major economic zones [27]; Luo Nengsheng and others comprehensively used GIS method and dynamic panel measurement method to evaluate and analyze the utilization efficiency of industrial land in large and medium-sized cities in China [28]; Tan Dan and others used questionnaire survey and multi-factor comprehensive evaluation method to evaluate and analyze the level of industrial land intensive use in three cities in Jiangsu (Changzhou, Nantong and Yancheng) [29]. Judging from the definition of evaluation scale, Qu Zhongqiong and others explored the evaluation method of inefficient industrial land parcels based on the micro-scale perspective and the principle of land saving, which provided a theoretical basis for local governments to manage inefficient industrial land in stages [30]; Guo Guancheng and others evaluated and analyzed the efficiency of industrial land use in Jintan from the micro-enterprise scale, and based on this, some relevant countermeasures for industrial structure optimization were obtained [31]; He Canfei and others also evaluated the land use efficiency of 4,529 electronic industries in Shanghai based on the survey of micro-enterprises, revealing that the establishment of development zones can promote the improvement of land use efficiency [9]; Liao Pingfan takes Jiayu Economic Development Zone as the evaluation scale, evaluates its land intensive use level by establishing an evaluation index system, and puts forward policy suggestions on how to improve the efficiency of industrial land use [32]; Jiang Xin took pinghu city as the evaluation scale and made an overall evaluation and analysis on the utilization efficiency of industrial land in this city [33]; Huang Daquan and others used the total factor productivity method to analyze and measure the efficiency of industrial land use in Fujian Province [34]; Peng Jianchao and others systematically studied the temporal and spatial differences and changing characteristics of industrial land use efficiency in different provinces and regions of China from 2001 to 2011 by using various spatial econometric methods on the basis of defining the connotation of industrial land use efficiency.

Looking at the above scholars' evaluation research on inefficient industrial land, the selection of evaluation indicators has gradually changed from a single indicator to multiple indicators, and the evaluation index system has changed from a simple perspective of economic benefits or land development and utilization to social, economic and ecological perspectives; The application of evaluation methods has gradually changed from the traditional ideal value method and multi-factor comprehensive evaluation method to DEA model and Malmquist index model, and at the same time, spatial visualization analysis has been carried out by combining "3S" technology; The selection of evaluation scale includes micro-scale parcel level and enterprise level, meso-scale development (park) areas, cities and counties and urban agglomerations, and macro-scale provinces, economic belts and even the whole country. Although the current evaluation of inefficient industrial land has achieved good research results to a certain extent, there are still some shortcomings. First of all, in the selection of evaluation indicators, although the selected evaluation indicators have gradually changed from a single indicator reflecting the economic benefits of urban land use to social, economic and ecological multi-indicators, most literatures still focus on economic indicators and the selection of environmental indicators is less or not representative and typical, so we should pay more attention to the consideration of ecological and environmental indicators when evaluating the efficiency of industrial land use in the future. Secondly, because it is difficult to obtain the relevant data of industrial land, the efficiency evaluation of most industrial land mainly focuses on the large-scale national, provincial and urban agglomerations, and there is relatively little research on small-scale space such as micro-enterprises and parcels. Thirdly, the evaluation methods for measuring the efficiency of industrial land use mostly focus on econometrics and spatial metrology, and the environmental externalities brought by industrial development are not considered enough. In the future, environmental related models can be introduced into the research process to explore and study.

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## IV. CAUSE ANALYSIS OF INEFFICIENT INDUSTRIAL LAND US

The causes of inefficient industrial land have always been a hot topic of concern to many scholars. Because the causes of inefficient industrial land are complicated and have certain timeliness and regionality, it also brings many difficulties to explore the causes of inefficient industrial land. Guo Guancheng and others used mixed model and fixed effect model to explore the influencing factors of industrial land efficiency in cities across the country, and found that industrial scale, land marketization level, industrial opening-up degree and industrial agglomeration degree are the main factors affecting industrial land efficiency [36]; Tamia Liu and others believe that the inefficiency of industrial land is closely related to the local government's economic development and tax base expansion [37]; Zhang Yuan and others believe that the reasons for the inefficiency of industrial land mainly include three aspects: the long supply of industrial land leads to the entry of inefficient industries, the existing benefit distribution mechanism determines the inefficiency of a large number of industrial land, and the short-sighted and blind competition of developers further lowers the industrial access threshold [38]; Xiao Jincheng and others believe that the imbalance of industrial structure and the unreasonable spatial layout of industrial land are important reasons for the low efficiency of industrial land [39]; Zhan Haibin believes that low land price and low plot ratio standard are the important reasons for the inefficiency of industrial land [40]; Ni Lianqi and others think that the volume ratio of industrial land, building coefficient and investment in fixed assets are important factors affecting the efficiency of industrial land [41]; Yu Wanglong and others used regression analysis to explore the influencing factors of regional industrial comprehensive efficiency, and found that industrial structure, level of resource endowment, expenditure on science and technology were significantly positively correlated with comprehensive efficiency, while the ratio of capital to labor, foreign direct investment and industrial comprehensive efficiency were significantly negatively correlated [42]; Cao Wenhui and others believe that enterprise type, enterprise function, enterprise ownership nature and whether it is a high-tech enterprise are important factors affecting the land use efficiency of industrial enterprises in Jiangsu Province [43]; Zhang Lin and others compared and analyzed the differences of influencing factors of land use efficiency between light and heavy industries from enterprise attributes, input factors, socio-economic factors and location factors [44]; Zhang Lin and others also found that land input, enterprise characteristics and external environment have obvious influence on the output efficiency of industrial land through the empirical study of micro-enterprise samples, and pointed out that improving the input intensity per unit land, guiding the rational layout of industrial enterprises and actively promoting the restructuring of state-owned enterprises are all conducive to improving the utilization efficiency of industrial land [45].

Looking at the above-mentioned scholars' exploration and research on the causes of inefficient industrial land, this paper tries to preliminarily summarize the causes of inefficient industrial land from three levels: government, market and enterprise. First of all, from the government's point of view, land transfer fees and land taxes are the main sources of local governments' fiscal revenue. Local governments attract investment by lowering the price of industrial land in order to develop the economy and improve their performance, which makes it relatively easy for enterprises to obtain land at a low cost. It is not uncommon for enterprises to use it, build it without investment, and invest it without meeting the standards. In addition, the land management system of government functional management departments is not perfect, and post-supply supervision is absent, thus a large number of inefficient industrial land have emerged. Secondly, from the market point of view, due to the incomplete competition of the market, the price of industrial land failed to meet reasonable expectations, and the low price of industrial land led to more industrial land available under certain capital conditions, and the increase in quantity often led to the decline in quality. Many industrial land was not fully utilized, and the phenomenon of idle waste also emerged one after another. Finally, from the enterprise's point of view, because of its own profit-seeking and weak awareness of saving and intensive, many enterprises speculate and make profits under the guise of doing industry, and occupy as much land as possible, only paying attention to plane expansion and lacking the awareness of vertical use of space, resulting in a large number of idle land waste, and inefficient industrial land came into being.

## V. RE-DEVELOPMENT AND UTILIZATION OF INEFFICIENT INDUSTRIAL LAND

Realizing the redevelopment and utilization of inefficient industrial land is the

ultimate goal of inefficient industrial land research. At present, the research on the redevelopment and utilization of industrial land in China is mainly carried out in different regions, and all regions have explored the secondary land development practices suitable for their own development according to local conditions. Chen Jiwei took Baoshan District of Shanghai as the research object, actively promoted the secondary development of land, encouraged enterprises to fully increase the floor area ratio by adding floors, rebuilding and expanding, reused idle factories by renting, and the government reclaimed the land property rights with old industrial structure and low return on investment to attract investment again, thus realizing industrial transformation and upgrading, functional optimization and industrial spatial layout adjustment in Baoshan District [46]. Yan Wei and Shen Jinde took Jiaxing City, Zhejiang Province as the research object, and started the redevelopment of inefficient land with the main content of "two retreats and two advances" (retreating from low to high and retreating from two to three), which has achieved initial results in revitalizing the existing construction land and alleviating the constraints of land elements [47-48]. Lin Jinfeng and others found that Dongguan City, Guangdong Province, through the "three old" transformation, "demolition of three to keep one" and other measures to improve the efficiency of industrial land significantly [49]. As far as the strategy of re-development and utilization of inefficient land is concerned, Chinese scholars have also carried out a lot of exploration and research. Peng Shanshan put forward the strategy of redeveloping inefficient industrial land in the development zone by measuring the potential of inefficient industrial land that may appear in four national-level development zones in Changsha, and emphasized that the government is the key [50]. Zhou Lianghua put forward a series of policy suggestions to build a long-term mechanism for the redevelopment of inefficient industrial land in cities and towns in China, mainly including formulating and perfecting the laws and regulations system for the redevelopment of inefficient industrial land, promoting diversified land leasing methods, establishing and improving the linkage mechanism of incentives and punishments, strengthening the comprehensive prevention and control of illegal land use, and promoting economic incentive policies such as economic compensation, interest guidance and green credit [18]. In the study of Wuhan Economic and Technological Development Zone, Zhang Xiaozhang and others put forward suggestions to revitalize inefficient industrial land, including refining the lease period of industrial land, regularly supervising and investigating and establishing a dynamic database, and introducing certain market competition mechanisms and incentive and punishment measures to promote the secondary development of inefficient industrial land [51].

Looking at the above-mentioned scholars' exploration and research on the redevelopment and utilization of inefficient industrial land, we can find that the countermeasures to promote the redevelopment and utilization of inefficient industrial land in different regions and at different stages of development have different emphases. Finding out the family background of the study area and defining the regional development orientation are the necessary prerequisites to realize the high-quality redevelopment of inefficient industrial land. In addition, Chinese scholars' research strategies on the redevelopment of inefficient industrial land mostly focus on the government's macro-control, with more emphasis on the government's planning and guiding role and the construction of relevant incentive and punishment mechanisms. There is relatively little research on how to improve and strengthen the role of market mechanism in the redevelopment of inefficient industrial land, but many scholars generally attach importance to the decisive role of market in the allocation of land resources, and all think that the role of market mechanism should be fully exerted.

## VI. LITERATURE REVIEW AND PROSPECT

By combing the research results of inefficient industrial land, this paper summarizes and summarizes the literature from four aspects: the concept connotation, evaluation research, cause analysis and redevelopment and utilization of inefficient industrial land. From the existing research literature, we can see that the concept connotation of inefficient industrial land has not yet formed a unified understanding, and clearly defining the concept connotation of inefficient industrial land is the primary prerequisite for the subsequent research on inefficient industrial land. Judging from the research results of inefficient industrial land evaluation, the selection of evaluation indicators is more diverse, systematic and comprehensive, which changes the traditional evaluation of industrial land efficiency from the economic point of view, and gradually turns to multi-index, multi-level and multi-angle to measure the efficiency level of industrial land. The evaluation methods are more diversified, and the

evaluation scale includes micro, meso and macro, so the evaluation of inefficient industrial land has achieved good research results to a certain extent. However, as far as the current evaluation of inefficient industrial land is concerned, it still focuses on the consideration of economic indicators and lacks the optimization of ecological environment indicators. The subsequent evaluation research of inefficient industrial land should pay more attention to the environmental externalities generated in the process of industrial land use and pay more attention to the selection and consideration of typical ecological environment indicators. In addition, in the future, we will pay more attention to the land use efficiency of micro-enterprises on the scale of inefficient industrial land evaluation, and gradually promote the integration of micro-enterprise data information. From the exploration and research on the causes of inefficient industrial land, how to accurately locate the roles and functions of government, market and enterprises in the whole life cycle management of industrial land transfer, development, utilization and supervision will be a scientific problem to be discussed in the future. Judging from the research results of the redevelopment and utilization of inefficient industrial land, how to formulate policies for redevelopment and utilization according to time, place and technology, establish a set of practical and effective mechanisms for redevelopment and utilization, and form a redevelopment and utilization model with certain characteristics will be the research direction of the redevelopment and utilization of inefficient land in the future.

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