SWOT analysis of industrial site redevelopment in mining area of Resource-based City-- Taking Pingshuo, Shanxi Province as an example

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Abstract. An important problem to be solved in the transformation and development of resource-based cities is the redevelopment and utilization of industrial sites in mining areas. This paper takes Pingshuo Coal Mine as an example, SWOT analysis model is used to analyze the four factors of advantages, disadvantages, opportunities and risks. The result shows that the dominant factors are the existing transportation, electricity, water supply, heating and sewage treatment facilities. The weaknesses are potential pollution risks and difficulties of facility retrofit. The opportunity is brought about by new urbanization and new rural construction. The challenge is how to attract people to the industrial areas with depleted resources.

Key words: Resource based city; industrial site; reuse; SWOT.

1. Introduction
The Sustainable Development Plan of Resource-based Cities released in November 2013 for the first time defined 262 resource-based cities, including 76 coal mine based cities (including 44 prefecture-level cities and 32 counties /districts) [1]. According to the annual capacity, the coal mines are divided into small, medium and large coal mines. According to the National Development and Reform Commission statistics in 2017, the number of various types of coal mines is more than 8000. With the depletion of resources, the subsequent closure of coal mines, coal mines also faces problems in the reutilization of industrial sites, which will be one of the important issues facing the resource-based cities in transition. [2-3]

2. The basic situation of Pingshuo mining area and SWOT model
2.1. General situation of industrial site in Pingshuo mining area
Pingshuo mining area is located in the eastern part of the Loess Plateau, northern Shanxi Province, located in the northern tip of Ningwu coal field in Shanxi Province, across Shuozhou Pinglu, Shuocheng two districts [4]. Pingshuo Coal Mine currently has three large opencast mines with an annual production capacity of 20 million to 30 million tons, three modern coal mines with an annual production capacity of 10 million tons, and six coal washing plants with an annual washing capacity of 125 million tons, 4
railway lines with a total transport capacity of 100 million tons [5]. This study involves the industrial areas of Antaibao, Anjialing, No.1 well, No. 2 well and gangue power plants, which mainly include mining areas of coal mines, transportation area, coal processing area and auxiliary areas with a total area of 437.2 hm$^2$ (6558.0 acres), see Figure 1.

2.2. **SWOT Analysis**

SWOT analysis, also known as the situation analysis method, was first proposed by Heinz ·Vergique from the University of San Francisco in the 1980s. It is a more accurate and objective way to analyze the reality [6-7]. SWOT analysis refers to the main internal strengths, weaknesses and external opportunities and threats that are closely related to the research object, which are listed in the survey and arranged according to the matrix. The idea of systematic analysis is used to match various factors and analyze them so as to draw the corresponding conclusions, and the conclusions usually are beneficial for decision-making [8-9]. The SWOT Rectangular Analysis is shown in Figure 2. The letter distribution represents strength, weakness, opportunity, and threat. Overall, SWOT can be divided into two parts: the first part is SW, mainly to analyze the internal conditions, the second part is OT, mainly to analyze the external environmental conditions. By using this method, the factors which are favorable and unfavorable for the development can be found as well as the solutions, and the future development direction can be determined.
3. SWOT analysis of industrial site reuse in Pingshuo mining area

3.1. Overall analysis of SWOT matrix

In general, the external favorable opportunities for the coal mining industry include the social background of ecological civilization construction and national resource city planning (2013-2020) have put forward requirements and provide policy support for the treatment and reuse of wasteland and the management of ecological environment [10]. The external risk is the relatively simple industrial structure of Shuozhou, a typical resource-based city, which can’t provide corresponding support for the industrial transfer in the reuse of industrial sites. At the same time, the Pinglu District where the Pingshuo Mining Area is located has relatively weak attraction to talents due to environmental and socio-economic factors. Judging from the conditions of the coal mining industry itself, the advantage lies in the fact that the ecological industrial chain has been under construction. As the first large-scale foreign investment enterprise in China, the Antaibao Coal Mine has a typical representative and relatively completed infrastructures including transportation, water supply, heating, electricity supply, etc.. The disadvantage is that on the one hand, long-term coal washing and processing caused the cumulative effect of pollutants in the atmosphere, water, soil and other media of the industrial site, resulting in a greater risk of pollution, on the other hand, as the industrial site is in an ecological fragile district with limited ecological carrying capacity and limited population supporting capacity, which has become an unavoidable limiting factor. The SWOT matrix for industrial site reuse is shown in Table 1.

Table 1. The SWOT matrix of industrial site reuse.

| External conditions | Internal conditions | Strength | Weakness |
|---------------------|---------------------|----------|----------|
| Opportunities       | SO strategy         | continuous industry, typicalness, and some infrastructure | risk of pollution, weakness of ecological environment carrying capacity |
| Ecological civilization construction, resource-based city planning, new urbanization, pilot project of industrial and mining wasteland use | Seize the opportunity, speed up construction and strive to establish a typical nationwide | Use the country's advantage, and actively guide and carry out pollution control and ecological restoration |
| Threat              | ST strategy         |           |          |
| Insufficient motivation for industrial transfer, it is difficult to attract population | Test and popularize the existing achievements, strengthen and improve supporting projects | Governance and control pollution and ecological risk, mainly protective reuse |

Figure 2. Rectangle analysis diagram for SWOT
3.2. **Detailed SWOT strategy analysis**

3.2.1. **SO strategy analysis.** Pingshuo Mining District has initially completed the construction of industrial chain and ecological industrial chain, and gradually built two types of core circular economy industrial chain: coal mining - coal gangue (including coal, etc.) - electric - silicon aluminum - building materials industry, black industrial Chain; agriculture - forestry - animal husbandry - medicine - agricultural products processing - eco-tourism green eco-industrial chain, mining industry - eco-industrial chain (He Zhenwei, 2012). The completion of industrial chain and ecological industrial chain not only can provide a good reference for the direct reuse of coal mining industrial sites, but also can provide a good ecological security support for the reuse of industrial sites. Antaibao Coal Mine is the first large-scale Sino-foreign joint ventures open pit in China, it is the experimental field of reform and opening up in China. The construction of Anjialing and East open-pit mine has made Pingshuo mine an extra large open-pit coal mine in China and one of the 13 major coal bases in China. The development and evolution of Pingshuo coal mine is a microcosm of the coal mining and washing business in China, showing great representative. The industrial sites already have certain external transportation facilities and internal infrastructures such as water supply, power supply and heating in the process of coal washing, auxiliary production, loading and transportation, which can also provide support for the follow-up utilization of industrial sites. In short, Pingshuo Coal Mine should give full play to its own advantages. Combining the existing national, provincial, municipal and county (district) favorable policies and measures, preparations should be made for the reuse of subsequent industrial sites ahead of the closure of the coal mine.

3.2.2. **ST strategy analysis.** Although Pingshuo Mine has its own advantages in terms of industrial chain, creating history and infrastructure, Shuozhou City, due to the characteristics of mineral resources cities, cannot provide a good industrial transfer project for the reuse of industrial sites. At the same time, it is difficult to attract people to this place. After all, the reuse of industrial sites is to serve the people. Whether the industrial sites can be successfully reused depends on whether it can attract people to engage in productive activities and live there. This requires the mine area to do its utmost to exert its own advantages and try to avoid external adverse risks. On the one hand, it is necessary to promote and publicize the existing achievements in Pingshuo Mining Area, such as advanced coal mining technology, demonstration base of reclamation test, design of industrial chain and so on, thus expanding the influence of Pingshuo Mining District or Shuozhou City nationwide; On the other hand, the layout of the overall infrastructure in the mining area should be improved so as to create a better hardware and software environment for the introduction of industries and population.

3.2.3. **WO strategy analysis.** The reuse of coal mine industrial sites has enjoyed solid policy support at the external macro level, but there are some constraints such as potential pollution risks and weak ecological environment carrying capacity in the internal conditions. From the analysis of the previous chapter, it can be seen that from the type of soil pollutant, the risk of heavy metal pollution in industrial sites is relatively small, and the risk of PAHs pollution is great. Among them, CHR, BbF, BaP and IPY are the most serious pollutants. From the perspective of the distribution of soil pollution, explosives plants, coal washing plants, oil depots and repair shops are at greater risk of contamination, while sewage treatment plants, gangue power plants and office areas have a lower risk of pollution. Therefore, it should make full use of existing national policies on soil pollution control and win the support of national project funds on the basis of identifying pollutants, the degree of pollution and the scope of pollution so as to control pollution risks in industrial sites. Combined with the design and implementation of the ecological industrial chain in Pingshuo Mining Area, the ecological environment carrying capacity (including the development and transfer of water resources) around industrial sites should be continuously strengthened.
3.2.4. WT strategy analysis. In response to the lack of internal conditions and the risk of external threats, a strategy of contraction and prudence should be implemented. Measures should be taken for the prevention and control of pollution risks in industrial sites and for the restoration of ecological environment. In the early stage, measures should be focused on the protective reuse of industrial sites. For example, The industrial sites can be transformed into cultivated land, woodlands, grasslands, etc., and the introduction of industries and population will not be considered for now. When the risk of environmental pollution in industrial sites has been effectively controlled and the conditions for the introduction of industries and population around industrial sites have become more mature, the productive reutilization will be implemented. Otherwise, the protective measures should focus on prevention and control.

In short, the reuse of industrial site should take full advantage of its own strengths by taking the external policies, economic, social and natural environments into consideration, in accordance with the harmonious development with surrounding natural landscape and human environment. It should give full play of its advantages and avoiding disadvantages, seize the external opportunities and avoid risks so as to maximize the social, economic and ecological benefits from reusing coal mine industrial sites.

4. Conclusion

Through the SWOT analysis of the reuse of Pingshuo coal mine industrial sites, the existing advantages include the existing infrastructures such as transportation, power supply, water supply and heating and sewage treatment. The disadvantages include potential pollution risks, difficulties in retrofitting facilities. The opportunity is brought about by new urbanization and new rural construction. The challenge is how to attract people to the industrial areas with depleted resources.

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