

Research on Site Selection of Datong Railway Logistics Park based on SE-DEA Model

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Abstract. In order to actively integrate into The Belt and Road Initiative and promote the integrated development of basin cities in central Shanxi, the Shanxi provincial government and the Taiyuan Railway Bureau proposed to build several comprehensive logistics parks. As one of the three regional logistics parks planned by Taiyuan Railway Bureau, the site selection of Datong railway logistics park need to be carried out urgently. At the same time, it is widely known that railway transportation is an important mode of transportation in the intermodal transport, and the site selection and construction of railway logistics park is also the key to promote the development of intermodal transport in China. For the above problems, this paper systematically combs and summarizes the factors of railway logistics park site selection and constructs the evaluation index system of railway logistics park location selection, including condition of market demand, station operation, station traffic and planning prospect. Through site survey, 11 existing railway freight stations in Datong city are selected as optional points. The super-efficiency DEA model and the evaluation index system of site selection are used to calculate the scheme. Finally, the scheme shows that Zhoushizhuang Station with the highest comprehensive efficiency value is the location of Datong Railway Logistics Park.

Keywords: site selection; SE-DEA model; logistics park; railway; intermodal.

1. Introduction

Railway logistics park is a space based on railway resources such as railway freight yards and stations, which integrates modern logistics management concepts and service concepts, is established in important railway transport hubs and areas where various modes of transport converge and develop rapidly and mainly provides modern logistics services with railway transportation. According to the *Railway Logistics Base Layout Plan and Construction Plan for 2015-2017* issued by China Railway Corporation, 208 first-and second-level railway logistics bases and several third-level railway logistics bases would be planned and constructed in China. The railway logistics base is an important railway logistics park of China Railway Corporation for modern logistics transformation, supporting the construction of national logistics hubs and docking the country's major strategies. To establish railway logistics park, the first thing is to solve the problem of location planning in the city, which is the premise and foundation of the development of railway logistics park. The location of railway logistics park should be based on the principle of making full use of existing facilities, giving full play to the functions of existing railway facilities, and avoiding duplication of construction. Establishing Railway Logistics Park based on traditional railway freight station has become the key and breakthrough point for railway to develop in a modern logistics way. As one of the three regional logistics parks planned by Taiyuan Railway Administration, the site selection of Datong railway logistics park need to be carried out urgently.

In the process of location selection of railway logistics park, there are many qualitative problems such as land conditions, traffic conditions and logistics development conditions need to be solved. Data envelopment analysis (DEA) as a multi-input method provides good help for this. With the super-efficiency DEA model, the final efficiency evaluation value can exceed 1, which makes up for the deficiency of the traditional DEA model evaluation, and facilitates the evaluation and ranking of each decision-making unit. Therefore, this paper proposes a location method based on the super-

efficiency DEA model, analyzes the site selection of the Datong Railway Logistics Park, and provides theoretical support for the site selection of other railway logistics parks.

2. Literature Review

The site selection decision of the logistics park will affect its operating costs, efficiency and scale of future expansion. Reasonable logistics site selection can effectively reduce costs, optimize transportation networks, and coordinate logistics activities generated during production and consumption to ensure efficient operation of regional logistics systems. In view of the importance of the site selection of logistics parks, scholars have continued to expand the depth and breadth of research on site selection of logistics parks in recent years. Anjali Awasthi (2011) studied the site selection problem of urban distribution centers under uncertain conditions, identified 11 evaluation criteria, and used fuzzy theory to model decision parameters. Jianxun Tang (2013) studied the solution method for the location planning problem of variable capacity logistics park. Canser Bilir (2017) proposed a multi-objective supply chain network optimization model based on joint supply chain network optimization and competitive facility location. The model aims at maximizing profit and minimizing risk. Yingjun Xu (2018) established a site selection evaluation index system based on the factors of the site selection of green logistics park, constructed a single-objective decision-making model, and designed a model solution based on hybrid particle algorithm and alternate location heuristic algorithm.

In conclusion, the existing related articles show that there are few researches on the site selection of railway transportation and logistics facilities. Therefore, this paper studies the site selection of Datong railway logistics park based on previous studies, puts forward the site selection method of railway logistics park based on super efficiency DEA model, calculates the comprehensive efficiency value of each optional railway station, and obtains the location scheme of Datong railway logistics park.

3. Theoretical Model Construction and Empirical Analysis

3.1 Sample Selection and Index System Construction

Through site survey, 11 existing railway stations in Datong urban area are selected as optional points. 11 optional points are set as DEA model evaluation units. By summarizing the influencing factors of the site selection of railway logistics park, this paper establishes the evaluation index system of the site selection of Datong railway logistics park, which consists of 4 first-level indexes, 8 second-level indexes and 12 third-level indexes. Considering the connotation of indicators, market demand conditions, freight infrastructure and traffic conditions of stations are taken as input variables, and the freight volume and development planning are taken as output variables. The evaluation index of siting of Datong railway logistics park is shown in Table 1.

3.2 Data Collection and Calculation Results

The research data of this paper are obtained through site survey, searching for statistical data of railway departments, and expert scoring based on planning file. Among them, the data of market demand conditions and road traffic conditions are obtained through market research. The data of station operation conditions and railway traffic conditions are obtained through searching statistical materials from railway department. The data of development planning prospect are obtained through expert scoring based on *Datong City Overall Development Planning*. In this paper, MATLAB software is used to program and solve the super efficiency DEA model to measure the comprehensive efficiency of existing railway stations. The results are shown in Table 2.

Table 1. Evaluation index system of Datong railway logistics park location

One class	Two class	Three class	Variable type
Market demand conditions	Industrial goods source conditions	Number of surrounding industrial parks	Input variables
	Supply conditions of commercial goods	Number of surrounding markets	Input variables
Station operation conditions	Freight operation scale	Dispatch volume	Output variables
		Arrival volume	Output variables
	Freight infrastructure	Storage facility area	Input variables
		Capacity of freight lines	Input variables
Station traffic conditions	Rail-road combined transportation	Number of adjacent highways	Input variables
		Number of entrances and exits adjacent to Expressway	Input variables
	Railway traffic conditions	Station grade	Input variables
		Distance from the nearest technical station	Input variables
Development prospect	Urban logistics planning	Score of conformity with logistics development planning	Output variables
		Score of conformity with urban master plan	Output variables

Table 2. Efficiency evaluation value of optional site selection of Datong railway logistics park

Numble	Optional railway station	Efficiency evaluation value
1	Datong South Station	1.198
2	Datong East Station	3.000
3	Lake East Station	1.592
4	Yungang West Station	0.910
5	Zhou Shi Zhuang Station	9.189
6	Yungang Station	0.731
7	Gudian Station	2.119
8	YangGao Station	4.389
9	Tianzhen Station	2.570
10	Han Jialing Station	1.929
11	Xin Gaoshan Station	0.400

3.3 Analysis of Statistical Results

Through the analysis of the data, it can be seen that the evaluation results of 8 railway stations are greater than 1, which shows that DEA is effective and the overall efficiency of railway stations is high. This shows that Datong railway transportation has a strong foundation for development.

Through the comparative analysis of the efficiency evaluation value of each optional railway station, it can be seen that the comprehensive efficiency value of Zhou Shi Zhuang station is 9.189, which is the maximum value of 11 optional railway stations. From the single index evaluation result, Zhou Shi Zhuang station does not have prominent advantages, but its comprehensive efficiency is the highest. This shows the advantage of using DEA model in site selection analysis compared with other methods. It can consider all aspects of influencing factors as a whole, without giving subjective weight to the influencing factors, and the final result is presented in the form of comprehensive efficiency value.

From the actual site conditions, Zhou Shi Zhuang station is about 20 kilometers away from the center of Datong City, which is conducive to the development of urban distribution and other logistics

activities. The surrounding road traffic conditions are good, and it is close to Datong Equipment Manufacturing Industrial Park. Its location is highly matched with Datong City's urban planning, industrial layout planning and other spatial planning, which is suitable for the construction of large-scale railway logistics park. By giving full play to the advantages of large railway transportation capacity and environmental protection, it can better serve the development of regional economy.

In conclusion, through the analysis and comparison of 11 railway stations in Datong City, this paper selects Zhou Shi Zhuang station with the highest comprehensive efficiency value as the location of Datong railway logistics park. The result of Datong railway logistics park site selection is shown in Figure 1.



Fig. 1 The result of Datong railway logistics park site selection

4. Summary

This paper studies the site selection of Datong Railway Logistics Park, establishes the evaluation index system of Datong railway logistics park site selection according to the influencing factors of site selection of railway logistics park, and comprehensively evaluates each optional railway station based on the super efficiency DEA model. This paper draws the following conclusions.

1) The development of Datong railway freight transportation has a strong foundation. For the planning and construction of a railway logistics park, Datong City has a good foundation for development. At the same time, the construction of Datong railway logistics park can further promote the transformation of modern railway logistics and the development of regional logistics.

2) It is suggested to build Datong railway logistics park relying on Zhou Shi Zhuang station. Zhou Shi Zhuang station has the highest comprehensive efficiency evaluation value among 11 railway stations in Datong City. At the same time, the site of Datong railway logistics park is in Huayang Malina dry port functional area, which is development pattern of "five logistics functional areas around the city" proposed by *Datong City Development Planning*. The location plan is in good agreement with Datong city development planning.

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