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Research on Evaluation of High Quality Development of Construction Industry in Anhui Province

Jing Hu

School of Management Science and Engineering, Anhui University of Finance and Economics, Bengbu, Anhui, China

Abstract

Starting from the new development concept, this paper analyzes the high quality development status of Anhui construction industry. The evaluation index system of high quality development of construction industry in Anhui Province is constructed from five aspects: scale, development potential, benefit contribution, innovative development and green development. A comprehensive evaluation model of high quality development of construction industry based on entropy weight -TOPSIS model is established. The high quality development level of construction industry in 16 cities in Anhui Province was evaluated comprehensively. The results show that the high quality development level of the construction industry in Anhui Province is generally low, and the development level of Hefei city is better, but there is a huge gap between other cities and its development level is not balanced. Based on this, corresponding policy suggestions are put forward in order to provide reference for promoting the high quality development of construction industry in Anhui Province.

Keywords

Anhui Province; Construction Industry; High Quality Development; Entropy-topsis Model.

1. Introduction

Construction industry, as the pillar industry promoting national economy, has great potential for future market prospect development, and the development of related industries is high. The development of construction industry not only drives the direct development of Chinese economy, but also indirectly drives the relevant industries to develop continuously [1]. Under the leadership of the Party's new development concepts of innovation, coordination, green, open and sharing, the scale of China's construction industry is further increasing. In 2021, the total output value of China's construction industry will reach 29,307.83 billion yuan, an increase of 11 percent year-on-year in 2020. The Sixth Plenary Session of the 19th CPC Central Committee proposed that "high-quality development runs through all aspects of social, economic and life development". In the transition of national economy to high quality development, the construction industry also needs to shift from extensive development to high quality development, and improve its shortcomings of insufficient impetus for technological innovation and unbalanced development. At the same time, it should be noted that the development situation of the construction industry in each province is different, and the goals and positioning for achieving high-quality development are also different. It is necessary to carry out high-quality development evaluation of construction industry according to the actual situation of each province. At present, the high quality development of the construction industry in Anhui Province is still in the stage of waiting for improvement, and the image influence of the Hui-style construction brand still needs to be improved. It is urgent to find a road belonging to the high quality development of the construction industry in Anhui province. Anhui provincial government has also put forward the general goal of "strong economy, rich

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people and beautiful ecology" in the new stage of the construction of a modern and beautiful Anhui. Therefore, this paper takes Anhui Province as an example, establishes the high-quality development evaluation index system of the construction industry, takes 16 cities in Anhui province as the research object, studies the high-quality development evaluation model of the construction industry in Anhui province, focuses on the high-quality development trend of the construction industry in this province, and puts forward several policy suggestions and practical paths for the development status and work of the construction industry in this province. To further promote its high-quality development.

2. Review of High Quality Development Research in Construction Industry

Although the academic circle has made some achievements in the research on the connotation of high-quality economic development, but no unified definition has been formed, but most scholars regard "economic growth" and "development quality" as the two key aspects of high-quality economic development. Therefore, the research on the development of the construction industry is mainly focused on the quality of the construction industry and the relationship between the construction industry and economic growth. Sabatini F [2] pointed out that the connotation of economic development quality includes human, society and nature. In the study of economic quality growth, economic growth was not only considered, but also the dimension of people's livelihood welfare was introduced to describe economic growth. Abdel-Wahab et al. [3] made a comparative analysis of Britain, the United States and Japan, and found that poor total factor productivity would lead to low construction quality. Matinaro pointed out that innovation is the key to the sustainable development of the construction industry, and took Finnish construction enterprises as an example to empirically analyse the importance of innovation to the sustainable development of the construction industry.

There are many researches on the construction of high quality development index system in the construction industry. Xu Liting et al. [4] took the Yangtze River Delta urban agglomeration as a case area, used entropy-Topsis model to evaluate the change and difference of urban ecological level, and used the obstacle degree model to explore the main obstacle factors affecting the urban ecological level, and found that the ecological level of the Yangtze River Delta urban agglomeration has been steadily improved, showing a "center - periphery" structure in space. For most cities, the economic level, infrastructure and public service elements are the result of the main obstacle factors. Based on the new development concept, Fu Weizhong et al. [5] analysed the connotation of high-quality development of the construction industry, constructed an evaluation index system of high-quality development of the construction industry from eight levels, and conducted a comprehensive evaluation based on entropy weight method and cluster analysis. The results showed that the development scale, innovative development and development potential were the main aspects affecting the high-quality development of the construction industry. The high quality development level of the construction industry in the Yangtze River Delta is low on the whole, and the gap between cities is obvious and the development level is uneven. Yang Chengqian et al. [6], starting from the connotation of high-quality development of the construction industry, combined with the development characteristics of the construction industry in Hubei Province, constructed an evaluation system of high-quality development of the construction industry in Hubei province from five aspects: industrial scale, industrial benefit, technical equipment, industrial efficiency and development potential, and evaluated the development quality level of the construction industry in Hubei Province in the past 20 years with the help of factor and cluster analysis. It is found that there is still a large gap between its development status and the requirement of high quality development, and based on this, the corresponding policy suggestions are put forward.

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3. Construction of High Quality Development Evaluation Index System of Anhui Construction Industry

3.1. Evaluation Index Selection

In order to make a more comprehensive and fair evaluation on the high-quality development of the construction industry in Anhui Province, this paper adopts the five development concepts of innovation, coordination, green, open and sharing as the core in the principles of science, system and quantification, and combines the indicators selected by previous scholars to study the high-quality development of the construction industry to select the following indicators to form a system. To fully embody the concept and connotation of high quality development of the construction industry.

From the perspective of opening up, expanding the market and making it more dynamic is the embodiment of openness, and scale is the embodiment of market share and vitality. The scale can be measured by the total output value of the construction industry, the number of enterprises in the construction industry, the total output value of enterprises in the construction industry, the completion rate of building floor area and the added value of the construction industry.

Development potential is an estimate of future development. Measured by the GDP growth rate of construction industry, per capita disposable income and urbanization rate at the present stage, the GDP growth rate of construction industry reflects the growth capacity, per capita disposable income reflects the consumption capacity, and urbanization rate reflects the level of urban development.

Benefit contribution can drive a variety of resources to carry out a deeper transformation of the construction industry, which is a direct reflection of the value of the construction industry, but also a guarantee to maintain the high-quality development of the construction industry. The contribution rate of the construction industry to GDP and the asset-liability ratio are used to measure the industrial structure coordination. As the purpose of coordinated development, sharing needs to start from the perspective of enterprise operating conditions and social welfare, which is specifically manifested as the total profit.

Innovative development is the direct driving force for high-quality development. The purpose of innovation in the construction industry is to drive innovation and improve efficiency, in order to achieve the ability level required for high-quality development. The net value of its own construction machinery and equipment and the total power of its own construction machinery and equipment are used to measure.

Green development is not only the core element to show the new development concept, but also the necessary component to realize the sustainable development of industry. The green development of the construction industry needs to avoid excessive consumption of resources and continue to improve capacity while maintaining good efficiency. The indexes of industrial wastewater treatment rate, green coverage rate of built-up area and comprehensive utilization rate of industrial solid waste were selected for measurement.

3.2. Construction of High Quality Development Evaluation Index System

The above evaluation indexes are selected to construct an evaluation index system for the development quality of construction industry in Anhui Province, which includes 5 first-level indexes and 16 second-level indexes, as shown in Table 1.

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Table 1. Evaluation index system of high quality development of construction industry in Anhui Province

First-order index	Secondary index	unit
Scale level	Gross output value of construction industry X_1	Ten thousand yuan
	Number of construction enterprises X_2	a
	Total assets of construction enterprises X_3	Hundred million yuan
	Value added of construction industry X_4	Hundred million yuan
Development potential	Growth rate of construction gross domestic product X_5	%
	Per capita disposable income X_6	Yuan/person
	Completion rate of building floor area X_7	%
	Urbanization rate X_8	%
Benefit contribution	Total profit X_9	Ten thousand yuan
	Contribution of construction industry to GDP X_{10}	%
	Asset-liability ratio X_{11}	%
Innovative development	Net worth of its own construction machinery and equipment X_{12}	Ten thousand yuan
	Total power of self-owned construction machinery and equipment X_{13}	megawatt
Green development	Industrial wastewater treatment rate X_{14}	%
	Green coverage of built-up areas X_{15}	%
	Comprehensive utilization rate of industrial solid waste X_{16}	%

3.3. The Original Data of High Quality Development Evaluation Index of Construction Industry in Anhui Province

The data used in this paper mainly comes from 16 indicators in 2021 of 16 cities such as Hefei, Huaibei and Bozhou in Anhui province. Entropy-topsis method is used to construct an initial matrix to carry out high-quality development evaluation of the construction industry. The original data analyzed were from Anhui Provincial Statistical Yearbook and the statistical yearbook of each city. Among them, the index data that cannot be obtained directly are obtained by converting the original data. For example, the contribution rate of the construction industry to GDP is obtained by dividing the gross domestic product of the construction industry by the GDP of the current year and multiplying by 100%. The missing data were interpolated by the annual growth rate method.

4. Evaluation and Analysis of High Quality Development of Construction Industry in Anhui Province

4.1. Entropy-topsis Model

Entropy weight method is one of the objective weighting methods, which can effectively reflect the role of indicators in the evaluation of the subject. Information entropy represents the degree of dispersion of index data. The greater the degree of disorder of index, the higher the degree of dispersion, the greater the information entropy, and the smaller the weight of index. On the contrary, the lower the dispersion degree of indicators, the smaller the information entropy and the greater the weight it occupies [7]. TOPSIS method is one of the evaluation

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methods based on multi-objective decision-making. By identifying the maximum and minimum values of each index in the target, it is defined as positive ideal solution and negative ideal solution respectively. On this basis, the distance between the index and the positive and negative ideal solution, namely the closeness degree, is measured, and the pros and cons are ranked.

Entropy-topsis model effectively combines entropy-weight method with TOPSIS method, and has the advantages of operability and objectivity. TOPSIS method uses entropy weight to calculate the optimal solution, the worst solution and their distance of each index of the research object, and obtains the progress of each index of each city. The greater the progress value, the higher the high-quality development level of the city's construction industry, and the smaller the proximity value, the lower the high-quality development level of the city's construction industry.

4.2. Data Processing

1) Normalization of original data matrix

The purpose is to eliminate the dimensional influence of indicators and make them comparable. Specific methods are as follows:

Positive indicators:

$$x'_{ij} = \frac{x_{ij} - \min(x_{1j}, x_{2j}, \cdots, x_{nj})}{\max(x_{1j}, x_{2j}, \cdots, x_{nj}) - \min(x_{1j}, x_{2j}, \cdots, x_{nj})} \quad (1)$$

Negative indicators:

$$x'_{ij} = \frac{\max(x_{1j}, x_{2j}, \cdots, x_{nj}) - x_{ij}}{\max(x_{1j}, x_{2j}, \cdots, x_{nj}) - \min(x_{1j}, x_{2j}, \cdots, x_{nj})} \quad (2)$$

Where, x'_{ij} is the jth index value of the ith city($i = 1,2, \ldots, n; j = 1,2, \ldots, m$).

2) Defined entropy

In the high quality evaluation system of Anhui construction industry with n evaluation indexes for m research object, the entropy of the jth index is $h_j = -k\sum_{i=1}^{m} f_{ij} \ln f_{ij}$, where $f_{ij} = x'_{ij} / \sum_{i=1}^{m} x'_{ij}$, $k = 1/\ln m$ (when $f_{ij} = 0, f_{ij} \ln f_{ij} = 0$)[8].

3) Define entropy weight

After defining the entropy value of the jth index, the entropy weight of the jth index can be obtained:

$$w_j = \frac{1 - h_j}{n - \sum_{j=1}^{n} h_j} \left(0 \le w_j \le 1, \sum_{j=1}^{n} w_j = 1\right) \quad (3)$$

4) Calculate the level of development score

$$g_i = \sum_{j=1}^{n} x_{ij} w_{ij} \quad (4)$$

Where, g_i is the score of high-quality development level of construction industry in the ith city.

4.3. Results and Analysis

Table 2. Weight of each evaluation index of high quality development of construction industry in Anhui Province

	Index	Weight		Index	Weight
Scale level	X_1	0.131	Innovative development	X_{12}	0.128
	X_2	0.045		X_{13}	0.123
	X_3	0.135	Green development	X_{14}	0.026
	X_4	0.093		X_{15}	0.014

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Development potential	X_5	0.008		X_{16}	0.013
	X_6	0.057			
	X_7	0.031			
	X_8	0.032			
Benefit contribution	X_9	0.097			
	X_{10}	0.045			
	X_{11}	0.023			

According to the above steps, the weight of the evaluation index is calculated through the entropy-Topsis model, as shown in Table 2. Then, the evaluation value of the city-level index is calculated. On this basis, the comprehensive evaluation score of the high-quality development of the construction industry in each city is calculated, namely, the closeness and TOPSIS ranking, as shown in Table 3 and Table 4.

Table 3. Evaluation results of high-quality development level of construction industry in Anhui Province

City	Scale level	Development potential	Benefit contribution	Innovative development	Green development	Composite score
Hefei City	1.000	0.646	1.000	1.000	0.703	0.860
Huaibei City	0.007	0.337	0.199	0.008	0.447	0.205
Bozhou City	0.061	0.308	0.056	0.000	0.439	0.182
Suzhou City	0.104	0.365	0.264	0.323	0.557	0.272
Bengbu City	0.137	0.267	0.340	0.093	0.800	0.276
Fuyang City	0.098	0.280	0.068	0.072	0.604	0.194
Huainan City	0.034	0.451	0.176	0.011	0.271	0.206
Chuzhou City	0.156	0.417	0.286	0.055	0.651	0.251
Lu 'an City	0.071	0.214	0.148	0.058	0.776	0.196
Ma 'anshan City	0.102	0.591	0.374	0.113	0.469	0.305
Wuhu City	0.209	0.743	0.382	0.096	0.739	0.333
Xuancheng City	0.074	0.582	0.220	0.016	0.780	0.256
Tongling City	0.067	0.402	0.257	0.040	0.412	0.200
Chizhou city	0.052	0.520	0.204	0.019	0.533	0.230
Anqing City	0.113	0.435	0.168	0.146	0.555	0.226
Huangshan City	0.028	0.426	0.171	0.014	0.702	0.212

The weight of each index is obtained through the entropy method. The greater the weight, the greater the influence on the high-quality development of the construction industry. As can be seen from Table 2, among the first-level indicators, scale level and innovative development have a large weight, indicating that in the current stage, the high-quality development of the construction industry in Anhui province cannot be achieved without the improvement of scale

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level and innovative development. In further realizing the high-quality development of the construction industry in Anhui Province, it is necessary to not only ensure the improvement of scale, but also increase the investment in technological innovation and new equipment. Actively use machinery instead of manpower to improve efficiency. In the secondary index, the indexes larger than the weighted average 0.0625 are: total output value of the construction industry, total assets of construction enterprises, added value of the construction industry, total profit, net value of self-owned construction machinery and equipment, total power of self-owned construction machinery and equipment. These are important factors affecting the high quality development of the construction industry in Anhui province, and relevant departments should pay attention to them in the process of formulating policies.

Table 4. Ranking of high-quality development level evaluation of construction industry in Anhui Province

City	Scale level	Development potential	Benefit contribution	Innovative development	Green development	Overall ranking
Hefei City	1	2	1	1	5	1
Huaibei City	16	12	10	15	13	12
Bozhou City	12	13	16	16	14	16
Suzhou City	6	11	6	2	9	5
Bengbu City	4	15	4	6	1	4
Fuyang City	8	14	15	7	8	15
Huainan City	14	6	11	14	16	11
Chuzhou City	3	9	5	9	7	7
Lu 'an City	10	16	14	8	3	14
Ma 'anshan City	7	3	3	4	12	3
Wuhu City	2	1	2	5	4	2
Xuancheng City	9	4	8	12	2	6
Tongling City	11	10	7	10	15	13
Chizhou city	13	5	9	11	11	8
Anqing City	5	7	13	3	10	9
Huangshan City	15	8	12	13	6	10

As can be seen from Table 3, the development level of the construction industry in Anhui Province is mainly 0.2-0.3, which indicates that the development level of the construction industry in Anhui Province is average and its overall strength is weak. Among them, Hefei ranked the first, showing that the high quality development level of the construction industry

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of Hefei is in the forefront of Anhui Province, reflecting the leading position of Hefei as the capital city of Anhui Province in the high quality development of the construction industry. The comprehensive scores of Wuhu, Ma 'anshan, Bengbu and Suzhou are all greater than 0.27, and the score gap is not big, showing similar development level and good strength. Xuancheng City, Chuzhou City, Chizhou City and other cities have a medium level of development. Bozhou City, Fuyang City, Lu 'an City and other cities are ranked at the bottom, with poor quality development of construction industry and relatively weak strength.

Further analysis shows that the score of high quality development level of the construction industry of Hefei is 0.528 higher than that of the second place, Wuhu. While Hefei shows the strength of China's new first-tier city, it needs to recognize the imbalance of development. There is a huge gap between the high quality development level of the construction industry of other cities and that of Hefei. At the same time, Hefei ranks first in scale, benefit contribution and innovative development, but lags behind in green development and scores low in secondary indexes such as industrial wastewater treatment rate. As a new city developed in recent 10 years, urban expansion and accelerated infrastructure construction require attention to improve resource utilization rate and strengthen environmental protection in the future. Wuhu ranks the first in terms of development potential, and ranks the second in terms of scale and benefit contribution. While improving the personnel policy to attract more professional and technical personnel and scientific researchers, it will also pay attention to the improvement of greening and environmental protection, so that it will have a greater space for development. Bengbu ranks first in green development, but ranks 15th in development potential. It needs to pay attention to urbanization construction, attract talents, and build more leading enterprises with special grade and first-class general contracting qualifications. Bozhou City, Fuyang City, Lu 'an City and other cities are ranked low, with small development scale and weak development potential. Currently, they are in the early stage of development. Therefore, attention should be paid to promoting urbanization and improving infrastructure construction, attracting talents and implementing rural revitalization strategy to expand development scale.

5. Suggestions

The construction industry in Anhui Province is in the transition stage from quantity growth to quality improvement, and pays more attention to the sustainability of development and the degree of meeting needs. Based on the above research, the following countermeasures and suggestions are put forward:

1) Promote coordinated development of urbanization and accelerate regional economic development. The improvement of the overall level of high-quality development of the construction industry in Anhui province cannot be separated from the urbanization construction. At present, the high quality development level of the construction industry in Hefei has formed a significant difference with other cities, and the development level of the south of Anhui is also higher than that of the north of Anhui. In the future, governments need to provide both policy and financial support to backward regions, pay attention to infrastructure construction in these regions, make scientific and rational planning for urbanization development goals, and integrate into local characteristics.

2) Accelerate the transformation of innovation achievements and improve the technical level of the construction industry. The technical level of the construction industry in various cities needs to be continuously improved, especially the technical assembly rate and power assembly rate, and the research and development and application of new technologies such as BIM and prefabricated building should also be followed up. The government can select innovative application demonstration enterprises according to the breadth and depth of application of new technologies in project construction, allocate certain research and development subsidies

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and financial rewards, so as to promote the green innovation development of the construction industry in Anhui province.

3) Promote the open development of construction enterprises to improve their business level and profitability. Internally, enterprises will be encouraged to participate more in PPP government-enterprise cooperation, affordable housing construction and other projects, and actively expand into professional business; Externally, with the promotion of "One Belt and One Road" construction, guide construction enterprises to actively expand outside the province and international markets, improve market share and profit space. Enterprises participating in the construction of international projects will be rewarded by the government according to the contract amount, and more sophisticated enterprises will be encouraged to undertake large-scale projects at home and abroad.

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