

## **Empirical Research on Competitiveness of Strategic Emerging Industries in Guangdong**

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**Abstract.** The paper evaluates the competitiveness of strategic emerging industries in Guangdong by constructing a comprehensive evaluation system for strategic emerging industries' competitiveness and adopting analytic hierarchy process. The results show that the competitiveness of the strategic emerging industries in Guangdong Province is not optimistic, even the highest score for aggregate competitiveness gained by energy and environmental protection industries is less than 65. In the five first-level indicators, the lowest score for scale competitiveness was 46.33, which was followed by innovation competitiveness and environmental competitiveness with scores of 47.64 and 47.71 respectively. Therefore, to increase the competitiveness of strategic emerging industries, Guangdong should not only co-ordinate the development of strategic emerging industries in all regions and highlight the focus of regional development, but further increase financial input and optimize R&D funding input structure as so to create favorable environmental of innovation for strategic emerging industries. Besides, government policies should be initiated to guide the innovation in the context of market demand and promote the effectiveness of innovation.

### **Introduction**

Industry 4.0 has completely reshaped the global industrial competition landscape. China's comparative cost advantage has accelerated weakening, and strategic emerging industries have become strategic breakthroughs for sustained economic growth<sup>[1]</sup>. How to develop strategic emerging industries on new technology platforms, how to integrate into and master the high-end link of the global value chain with core technologies and professional services, and how to achieve value chain upgrades and industrial upgrades are important issues that Guangdong urgently needs to address. From 2011 to 2015, the total industrial output value of strategic emerging industries in Guangdong Province showed an overall upward trend, how competitive are they? What are the advantages and disadvantages of them? Studying and exploring these issues will help formulate targeted policies to promote strategic emerging development in Guangdong.

### **The Establishment of the Comprehensive Evaluation System for the Competitiveness of Strategic Emerging Industries**

The most direct research on competitiveness can be traced back to the topics discussed at the World Economic Forum starting in 1980 and the "Report on Competitiveness" formed in 1985, which took the national competitiveness as the direct research object to rank and evaluate the competitiveness of each country. Since then, Porter's "Diamond" theory provided a comparatively comprehensive analysis framework for the study of industrial competitiveness. However, this theory just emphasized the role of enterprises and markets in the promotion of industrial competitiveness and did not adequately describe the role of the government<sup>[2]</sup>. China's research on industrial competitiveness began in the late 1980s and early 1990s. Some scholars (Fan Gang, 1998; Guo Keshu, 2000; Cai Wei, 2002) studied the basic issues of industrial competitiveness such as the connotation, determinants, the evaluation criteria, and the indicator system of industrial competitiveness. Some scholars (Wei Houkai, 2002; Li Liping, 2010) conducted in-depth studies on regional industrial competitiveness, including its influencing factors, evaluation models, and

indicator system<sup>[3-4]</sup>. However, the current studies on industrial competitiveness are mainly about service industries such as industrial manufacturing and banking industries. The study of setting competitiveness evaluation based on the characteristics of strategic emerging industries is still a weak link.

Based on major technological breakthroughs and major development needs, strategic emerging industries have a leading role in the overall development and long-term development of the economic society, which are knowledge-and-technology-intensive with low material resources consumption, large growth potential and good comprehensive benefits. The competitiveness of strategic emerging industries is a manifestation of the comprehensive capability. Constructing a relatively reasonable and complete indicator system is the basis and prerequisite for objectively evaluating the competitiveness. This paper builds a comprehensive evaluation system including five first-grade indicators which are scale competitiveness, innovation competitiveness, market competitiveness, growth competitiveness, and environment competitiveness and 15 second-grade indicators including gross output value, total profit, the number of employees; output value of new products, proportion of R&D expenditure, the number of patents for effective invention; market share, product sales profit, the amount of loss, growth rate of gross output value, growth rate of total profit, growth rate of the number of employees; government funds, the proportion of industrial added value in GDP and the proportion of R&D expenditure in GDP. The system not only meets the characteristics of general industrial competitiveness, but also combines the characteristics of strategic emerging industries such as the highly knowledge-intensive characteristic, the innovativeness, and the institutional dependencies.

**The Evaluation Method of Competitiveness**

This paper uses the standardized method to add up and then calculate the total score of the index to evaluate the competitiveness index of strategic emerging industries in Guangdong Province. After obtaining the standardized values of all second-grade indicators for each industry, add up the weighted values to obtain the values of all first-grade indicators for each industry.

And then apply AHP to determine the weights of the five first-grade indicators and obtain the comprehensive competitiveness of the eight strategic emerging industries. Table 1 is the judgment matrix of the first-grade indicators, which is determined according to the expert scoring in AHP (consistency ratio is 0.005).

Table 1. Judgment Matrix of the Comprehensive Competitiveness of Strategic Emerging Industries

		Competitiveness in				
		Scale	Innovation	Market	Growth	Environment
Competitiveness in	Scale	1	1/3	1/3	1/2	1/3
	Innovation	3	1	3	2	3
	Market	3	1/3	1	1/2	1
	Growth	2	1/2	2	1	2
	Environment	3	1/3	1	1/2	1

Data Source: Basic data was scored by experts. The data in the table was obtained using R software.

**Comprehensive Evaluation of the Competitiveness of Strategic Emerging Industries**

Using the evaluation indicator system and evaluation method for the comprehensive competitiveness of strategic emerging industries in Guangdong Province, the quantitative evaluation of the competitiveness of eight strategic emerging industries in Guangdong Province is conducted on the basis of data in 2015. At the same time, in order to eliminate the impact of abnormal fluctuations of data on the analysis result, use the average growth rate from 2011-2015 as the growth rate.

Table 2 shows the final cluster centers of the competitiveness scores of eight strategic emerging industries in Guangdong Province at each first-grade indicator. The differences in the final cluster

centers can reflect the characteristics and differences in the competitiveness of eight strategic emerging industries. The scale competitiveness, innovation competitiveness, market competitiveness, and growth competitiveness of energy-saving and environmental protection industry and high-end electronic information industry all have strong relative advantages, especially the scale competitiveness, which is obviously superior to that of other strategic emerging industries.

The bio-pharmaceutical industry, marine industry and aerospace industry have relatively strong environment competitiveness, but other competitiveness of them is relatively weak. All the competitiveness of the new materials industry is relatively general except the scale competitiveness which is relatively strong. The solar photovoltaic industry and the new energy automobile industry have a great advantage in the growth competitiveness.

Table 2. Comprehensive Competitiveness Scores of Strategic Emerging Industries

	Competitiveness in					Comprehensive competitiveness
	Scale	Innovation	Market	Growth	Environment	
Energy-saving and environmental protection industries	91.96	76.20	54.76	48.81	51.79	64.17
Bio- pharmaceutical industries	28.61	37.98	46.65	58.83	69.57	48.16
New materials industries	49.52	43.80	36.43	38.01	25.48	39.02
Solar photovoltaic industries	23.46	44.61	42.70	71.20	16.71	44.54
New energy automobile industries	39.07	39.92	53.01	67.81	40.43	48.34
Marine industries	23.71	44.49	43.27	9.46	69.03	38.33
Aerospace industries	23.30	44.26	41.93	55.30	67.96	48.40
High-end electronic information industries	90.99	49.90	65.93	56.14	40.69	55.60

According to the judgment matrix of first-grade indicators in Table 1, the weights of scale competitiveness, innovation competitiveness, market competitiveness, growth competitiveness, and environment competitiveness are 0.0786, 0.3874, 0.1519, 0.2302 and 0.1519 respectively obtained by R software using AHP. The weights results show that innovation strength and growth potential of an industry are the most important factors that determine the comprehensive competitiveness of the industry.

The comprehensive competitiveness indexes of the eight strategic emerging industries in Table 2 indicate that the energy-saving and environmental protection industry and the high-end electronic information industry have higher comprehensive scores of 64.17 and 55.60. Both industries have extremely strong scale advantage and relatively strong innovation competitiveness, with a certain level of growth rate. They are in a leading position among the eight strategic emerging industries in Guangdong Province. The comprehensive scores of the bio-pharmaceutical industry, aerospace industry and new energy automobile industry are all around 48. These three industries have shown good growth potential and have occupied a certain market share of products, but attention should be paid to the formation of the scale effect and the cultivation of the innovation capability. The comprehensive score of the solar photovoltaic industry is 44.54, and its growth rates of output value and employees are high, with a strong industrial growth advantage. However, its industrial scale needs to be further expanded and the industrial structure needs to optimize and upgrade to some extent. The new materials industry and the marine industry have relatively low comprehensive scores, and all the competitiveness of them needs to be improved.

## Conclusions and Recommendations

Through the establishment of the comprehensive evaluation system for the competitiveness of strategic emerging industries, use AHP to evaluate the competitiveness of strategic emerging industries in Guangdong Province. The result shows that the competitiveness of strategic emerging industries in Guangdong Province is not optimistic for us, and the score of the energy-saving and

environmental protection industry which is the largest score, is lower than 65. Calculating the average values of the first-grade indicators of eight strategic emerging industries, we find that the average value of the scale competitiveness is lowest, which is 46.33. This is followed by the innovation competitiveness and the environment competitiveness, which are 47.64 and 47.71. Therefore, to improve the competitiveness of strategic emerging industries in Guangdong, we need to proceed from the following aspects:

First, coordinate the development of strategic emerging industries in various regions and highlight the priorities of regional development. In fact, in order to speed up the development of strategic emerging industries and support strategic emerging industries to expand their scales and enhance their competitiveness, Guangdong Province has successively issued equity investment plans for pilot projects and plans for smart manufacturing pilot projects of strategic emerging industries. The whole province responds to the call for the development of strategic emerging industries. However, the development has been uneven throughout the years<sup>[5]</sup>. Therefore, the government should formulate plans to coordinate strategic emerging industries in various regions and implement the survival of the fittest to the repeated industries according to their development levels and regional advantages. The government should also focus on dividing and determining the development direction of each region, build industries with regional characteristics, improve the development efficiency of the industries, avoid the generalization and weak pertinence of policies and formulate policies according to local conditions to promote the development of strategic emerging industries.

Second, fully play the role of market demand in driving the innovation to improve the innovation capability. Strategic emerging industries are essentially high-tech industries. Mastering key technologies is the core pillar for the development of strategic emerging industries. At present, for the status quo of the development of strategic emerging industries in Guangdong, although key core technologies continue to make breakthroughs, technology self-sufficiency rate reaches up to 71%, patent output continues to grow and Guangdong's effective invention patents and PCT international patent applications remain the first in China with PCT international patent applications accounting for more than 50% of the total in China, there is still a gap between the level of comprehensive scientific and technological progress of Guangdong and that of Beijing and Shanghai and the key technologies of strategic emerging industries have not yet been fully grasped and broken through, still depending on external support largely<sup>[6]</sup>. It is particularly important to note that the major stage in determining an industrial innovation system is the stage of transformation of intellectual property elements into economic performance. In terms of the conversion of patents into productivity, many "silent patents" lose their potential values due to the lack of a suitable "hatching soil". In the major body of patent applications in Guangdong, the proportion of patents of enterprises is still relatively low, which was 73.90% in 2010-2015, slightly lower than the national average of 74.88% in the same period. This is not conducive to improving the efficiency of innovation. Because the patent applications of scientific research institutions and universities far differ from market demand, the conversion rates of many patents are not high, resulting in low innovation performance. Therefore, we cannot emphasize the amount of invention patent applications or grants, but we should track what role the intellectual property elements play in the transition to economic benefits and social soft power. The formulation of relevant policies should gradually tend to increase the number and weight of the "conversion rate" and "implementation rate" of intellectual properties. Let market demand guides the direction of innovation to increase the conversion rate of innovation results.

Third, further increase financial input, optimize the R&D funding structure and provide environmental support for the improvement of the innovation capability of strategic emerging industries. Strategic emerging industries are industries with high risk, large demand for short-term investment and long return period. Thus, science and technology financial incentives are inevitable for strategic emerging industries. However, there is a gap between the ratio of R&D expenditures in GDP of Guangdong and that of Beijing and Shanghai which have a higher level of comprehensive technological progress in China. For example, Guangdong Province's ratio of R&D expenditure in GDP in 2014 was 2.37%, higher than the national level but far below Beijing's 5.95% and

Shanghai's 3.66%. Moreover, in the rankings of R&D expenditures of universities in China, the two universities in Guangdong Province are out of Top 20, which seriously restricts the contribution of universities to the development and supply of R&D<sup>[7-8]</sup>. Therefore, Guangdong Province needs to increase the proportion of R&D expenditures to ease the shortage of R&D funding for scientific research institutions. And then, the data of the "Guangdong Industrial Statistical Yearbook" and the "Guangdong Province Second R&D Resources Inventory" indicates that most of the R&D expenditures in Guangdong are used for experimental development, which is basically above 92%. The main reason for the formation of this structure is that the R&D activities in Guangdong Province are dominated by enterprises, and the enterprises increase investment in experimental development in order to maximize profits. However, basic research and applied research belong to the category of scientific research. They represent the frontiers of science and the ability and level of original innovation. They are the basis for the conduction of experimental development activities. The low proportion of R&D expenditures used in basic research and applied research will inevitably has a negative impact on the development of R&D activities. This is not conducive to the development of frontier science and original innovation and it is difficult to form a breakthrough in core technology, which will hinder the development of strategic emerging industries. Therefore, the funding structure of R&D expenditures in Guangdong Province needs to be adjusted, and investment in basic research and applied research should be raised to compensate for the lack of scientific research activities.

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