Evaluation and Election for Advanced Manufacturing Industry of Guangxi: Based on the Variation Coefficient Method

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Abstract. In the process of economic globalization, domestic and foreign industry adjustments and technology transfer have brought new opportunities for economic development. It is significant to develop advanced manufacturing in Guangxi, which helps achieve the 12th five-year goal and promotes deeper cooperation and communications with Southeast Asian Nations. This paper defines advanced manufacturing category by measuring manufacturing industry level in Guangxi and gives some advice based on local advantages.

Introduction

Development of advanced manufacturing industry inherently determines a country's international competitiveness. In recent years, many scholars have made researches about advanced manufacturing. Wu Xiao-bo analyzed the related theories of innovation and advanced manufacturing and put forward the four-dimensional theoretical model of advanced manufacturing industry which is based on industrial upgrading. He pointed out that advanced manufacturing is a comprehensive application of advanced manufacturing technology, advanced technology products, advanced business models and advanced manufacturing organization of production systems [1].According to the new characteristics and trends of global manufacturing ,Gong Wei-ping, Cha Wei-wei and Xue Bai summarized that advanced manufacturing industry made extensive use of advanced manufacturing technology, advanced manufacturing mode and industrial production systems with advanced network organization , generalized from a three-dimensional perspective of ultra-micro, micro and middle [2]. Da Shang-ming and Liu Xi-lin analyzed the development of advanced manufacturing industry from the perspective of complex industrial clusters. He believed that complex industrial clusters can promote China's advanced manufacturing technology. It's necessary to improve technique creative level and realize flexible manufacturing by constantly perfecting industry chain [3].

Advanced manufacturing meets the demand of the development of advanced productivity. Progressiveness is the primary characteristic of advanced manufacturing. People can understand its advances from the following aspects.

Technological advancement. It is the basic characteristic of advanced manufacturing. Advanced manufacturing technology can penetrate into research, design, production, management and marketing of the manufacturing enterprise, which made a difference in manufacturing production and management modes. Relying on the advanced production technology, enterprises can realize the digital, network, agility and intelligent.

Advanced management. All kinds of production resources can be organized more effectively with advanced management concepts. It is necessary to integration the enterprise value chain by innovative management ideas and we can make the competitive position in manufacturing.

Advanced industry. Separated from the traditional industries, advanced manufacturing industry has high added value and technical content, which usually refers to the high-tech industries or new industries.

Summary of advanced manufacturing

Summary of foreign advanced manufacturing

Developed countries have introduced policies and measures to develop advanced manufacturing industry since the 1990s. Traditional manufacturing enterprises increased investment in research and adoption of advanced manufacturing technology and management techniques in order to improve the competitiveness of the domestic manufacturing industry. By developing advanced manufacturing, United States, Germany and Japan and other countries optimized the industrial structure, changed the economic growth pattern and enhanced comprehensive national strength and international competitiveness.

Summary of domestic advanced manufacturing

China's ministry of industry and information technology has demonstrated clearly its goal of developing advanced manufacturing in 2010. It has become a common practice for governments to developing advanced manufacturing by actively promoting industrial policy guidance. The coastal areas have been at the forefront of developing advanced manufacturing in China. For example, Shanghai, Guangdong, Shandong are the better cities which develop advanced manufacturing.

With many years of development, China is a manufacturing powerhouse, after United States, and Japan. Three advanced manufacturing base have been formed which included the Yangtze and Pearl River deltas and the Beijing-Tianjin-Tangshan region. Northeast, Southwest, Northwest traditional industrial bases should be restricted. Wuhan, Changsha and other advanced manufacturing industry bases spring up in central china.

The present situation of Guangxi manufacturing industry

It is necessary to follow the trend of the contemporary world's manufacturing industry, actively promote the development of advanced manufacturing. In recent years, Guangxi encourages and supports the development of manufacturing especially advanced manufacturing, which helps to form core competition and keep competitive superiority in enterprises.

Guangxi industrial added value was 574.965 billion yuan in 2013.Above-scale industrial added value had increased 12.9% more than 2012, which was 3.2% higher than the national average. Thanks to the technological innovations"112 Project", Guangxi greatly enhanced the capability of independent innovation. From 2010 to 2012, the applications for patent had increased 2039 in Guangxi industrial enterprises. Guangxi manufacturing is an attempt to extend its influence reach further.

Guangxi has formed a number of feature backbone industries and industrial materials. The spatial distribution of advanced manufacturing industry bases initially formed and greatly promoted the optimization of industrial structure in Guangxi. Although the development of manufacturing industry in Guangxi is very fast, it still lags far behind some advanced regions.

The development evaluation of Guangxi manufacturing industry

The selection of evaluation index

According to the economy industry classification issued by national bureau of statistics, manufacturing refers to all of the secondary industry sectors except construction industry, mining, electricity, gas, water production and supply industry. This paper chooses relevant economic indicators in above-scale manufacturing industries which come from Guangxi statistical yearbook (2012) to measure manufacturing industry level. Those indicators include industrial increasing value ratio, tax from one hundred fixed assets, ratio of profits to cost ,all-member labor productivity , the ratio between one hundred million main business investment and R & D expenditure which separately reflect management level, economic benefits, technical level and investment in science and technology.

The selection of evaluation method

The evaluation of Guangxi manufacturing industry is a Multi-objective decision-making problem. There are many methods about multi-objective decision. Here we choose a relatively simple and practical method. The decision-making process is as follows.

(1).Establish indicators matrix. If there are n industries and each industry have m evaluation indexes, then these indicators and industry can form a n ×m matrix (called the index matrix).

(2).The standardization of those indicators. Indicators need to be normalized in order to eliminate the effects of dimensionless in the decision-making process. Specific processing steps are based on the gap between the maximum and minimum indicators of mathematical calculations. The calculation formula is as follows:

$$r_{ij} = \frac{x_{ij} - x_{j\min}}{x_{j\max} - x_{j\min}} \tag{1}$$

r_{ij} is the normalized value of j evaluation from i industrial sector. $x_{j\max}$ is the maximum value of all the j industry indicators, and $x_{j\min}$ is the minimum value of all the j industry indicators. Data were normalized according to the formula (1), and then standardized matrix can be obtained.

$$R = (r_{ij})_{n\times m} = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2m} \\ \cdots & \cdots & \cdots & r_{3m} \\ r_{n1} & r_{n2} & \cdots & r_{nm} \end{bmatrix} \tag{2}$$

$$i = 1, 2, 3.........n \qquad j = 1, 2, 3.... m$$

(3). Decide the weight of each index. We use the variation coefficient method to determine the weight of each index in this paper. The first step is to calculate the mean and standard deviation of each index. The second is to determine coefficient of variation (V_j). Then we can get the weight of each index (W_j) when the coefficients of variation get normalize.

$$v_j = {s_j}\Big/{x_j} \tag{3}$$

$$w_j = {v_j}\Big/{\sum_{j=1}^{m} v_j} \tag{4}$$

(4). The last is to calculate comprehensive index score of manufacturing sector. The formula is as follows

$$z_i = \sum_{j=1}^{m} w_j . r_{ij} \tag{5}$$

Evaluation and result analysis

We calculate the weight of each index according to the formula (1), (2), (3) and (4). The result is that industrial increase value ratio count for 0.07, tax from hundred fixed assets count for 0.182, ratio of profits to cost count for 0.118, and all-member labor productivity count for 0.528, the ratio between one hundred million main business investment and R & D expenditure count for 0.102.

Again according to the formula (5), the comprehensive index score is calculated in various industries. The score are sorted in descending order (Table 1).

Table 1 Comprehensive index score of Guangxi manufacturing industries

number	industry	score	number	industry	score
1	Tobacco industry	0.9568	15	Non-metallic and mineral products	0.1954
2	Pharmaceutical manufacturing Industry	0.4217	16	Fabricated metal industry	0.1921
3	Computers and electronic equipment Manufacturing	0.3135	17	Food manufacturers	0.1861
4	Petroleum processing, and Nuclear fuel processing industry	0.2945	18	Wooden products processing industries	0.1708
5	Communications equipment industry	0.2464	19	Agricultural products processing industry	0.1665
6	Transportation equipment manufacturing industry	0.2301	20	Rubber and plastic products	0.1594
7	Electrical and mechanical manufacturing	0.2283	21	Entertainment ,porting goods manufacturing	0.1534
8	Garment industry	0.206	22	Leather, furs and related products	0.1501
9	Auto manufacturing	0.2197	23	Nonferrous metal industries	0.1479
10	Furniture manufacturing	0.2163	24	Printing, reproduction of recorded media	0.1462
11	Beverage manufacturing	0.2117	25	Other Manufacturing	0.1394
12	Meter manufacturing	0.2081	26	Textile Industry	0.1324
13	Chemical industry	0.2024	27	Ferrous metals processing industry	0.1312
14	Specialized equipment Manufacturing	0.1973	28	Paper and paper products industry	0.1068

As is seen from the Table 1, Tobacco industry, pharmaceutical manufacturing industry, computers and electronic equipment manufacturing, petroleum processing, and nuclear fuel processing industry, communications equipment industry, transportation equipment manufacturing industry, electrical and mechanical manufacturing, garment industry and auto manufacturing ranked relatively high.

Tobacco industry is in the first place. By all indications, the development of this industry is in a very good level. China strictly controls tobacco and smoking is a serious health hazard. Therefore, tobacco industry should not be included in the advanced manufacturing category in Guangxi. Beverage manufacturing, furniture manufacturing, garment industry and farm product processing are also high on the list. But the technological level of these industries is not high. Because of the limitations of indicators, chemical industry doesn't rank high in comprehensive index score. Chemical industry belongs to the traditional industries in Guangxi, with strong market competitiveness and industrial cohesive force.

All things considered, advanced manufacturing industry in Guangxi includes the following sectors: pharmaceutical manufacturing industry, computers and electronic equipment manufacturing, petroleum processing and nuclear fuel processing industry, communications equipment industry, transportation equipment manufacturing industry, electrical and mechanical manufacturing, auto manufacturing and chemical industry.

Development strategies of Guangxi advanced manufacturing

Readjust the industrial structure and foster industrial clusters

The government of Guangxi Zhuang Autonomous Region should take strong measures to facilitate the merger and reorganization of enterprises, phase out backward production capacity, promote advanced manufacturing industry, and improve industry concentration and the efficiency of resource allocation. Efforts will also be made to reinforcing infrastructure, nurturing hi-tech industry, as well as remolding and upgrading traditional industries.

Industrial clusters have contributed to promoting manufacturing, which is an inevitable tendency of modern industry development and an important way of improving the regional competence. The role of high and new-tech industrial zones was fully exploited. Vigorous efforts were made to develop service providers for industrial application of high and new technologies and foster advanced industry base. According to rational industrial layout, enterprises in Guangxi increase of manufacturing industry clusters, promoting the upgrading of industrial sectors. Beibu gulf economic zone focuses on high technology which is relate electronic product. High-tech zone of Guilin must pay attention to biomedicine, new materials and new-energy and develop their own strong industries with local advantages. Liuzhou, the largest industrial base, should make full use of the resources and strength and foster three main industries of automobile, metallurgy and machinery manufacture.

Carry out export-oriented policy and open the ASEAN market

Guangxi is in the heart of China-ASEAN free trade area, linking asean and domestic markets, taking geographical advantages which helps two-way communication. Firstly, the government of Guangxi should make full use of these platforms such as China-ASEAN EXPO and business investment summit, carrying out export-oriented policy and expanding exchanges and trade with ASEAN nations. Secondly, compared ASEAN countries with Southwest of China, there are competitiveness and complementarities in the industrial structure. It is important to take concrete measures to regulate the export order and perfect quality system. Thirdly, a unified market must be built up without delay in order to promote the free flow of production factor, goods and services. Guangxi province gives priority to the advanced manufacturing industry which is comparatively scarce in ASEAN nations, achieving the win-win with joint effort.

Improve the technical levels and deepen cooperation

The independent innovation ability is quite weak in Guangxi, which has been one of barriers to development. Effective ways to break through this obstacle are School-enterprises cooperation and collaboration between companies by policies, incentives and leadership. It is very significant to carry out high technologies and innovation-driven tactics, fostering new industries such as information technology industry, bio-pharmaceutical and new-energy vehicles which become new economic growth points.

Promote amalgamations between producer services and advanced manufacturing

With the rapid development of economy and society, produce services have strengthened ties with manufacture industry .Produce services interacts well with advanced manufacturing ,which have an positive effect on the quality and efficiency of economic development. For example, Software and computer services industry can improve the production efficiency. Research & design services lie in upstream of industrial chain, enhancing the technical content of product, increasing additive value, improving the competitiveness of advanced manufacturing and high- tech industries.

Improving the coordination ability and service system, a better and sound investment mechanism will be built which is good for the development of advanced manufacturing in Guangxi.

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References

[1] Wu Xiao-bo, Theoretic models of advanced manufacturing based on industrial upgrading. J Studies in Dialectics of Nature, 5(2011)62 —67. (in Chinese)

[2] Gong Wei-ping, Cha Wei-wei, Xue Bai, Three-dimensional Theoretical Model and Charac-teristics of Advanced Manufacturing. J Academic Research,(6)2008.75—79.(in Chinese)

[3] Da Shang-ming, Liu Xi-lin, Development of advanced manufacturing based on complex industrial clusters. J Science & Technology Progress and Policy, (6)2005.11—12. (in Chinese)

[4] Donald Gerwin, Vinod Kumar and Siva Pal. Transfer or Advanced Manufacturing Techn-ology from Canadian Universities to Industry. The Journal of Technology Transfer, (17)199257 —67.

[5] Kenneth K. Boyer, and Mark Pagell. Measurement issues in empirical research. Advanced manufacturing technology, (18) 1996: 361-374.

[6] Andreas Efstathiades, Savas A. Tassou, George Oxinos , Antonios Antoniou. Advanced manufacturing Technology Transfer and Implementation in Developing Countries: The Case of the Cypriot Manufacturing Industry. Technovation , (20)2000: 93-102.

[7] Basant K. Kapur. Progressive services, asymptotically stagnant services, and manufacture-ng: Growth and structural change. J .Journal of Economic Dynamics and Control. 9 (2012) 369.

[8] Paolo G, Valentina M. Technology and international competitiveness: the interdependence between manufacturing and producer services [J]. Structural Change and Economic Dynamis9 (2009): 201-215.