

## Perspective and Discussion of Innovation Problem in Manufacturing Industry of Guangdong province

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### Abstract

**In the contest of the new round of industrial revolution and the “new normal” in China, the manufacturing industry of Guangdong Province is facing both domestic and international challenges and urgently needs to change the developmental mode. Innovation drives industry upgrading and propels manufacturing value chain of Guangdong province. This paper analyzes the status quo and problems of innovation development of manufacturing in Guangdong Province, and proposes countermeasures regarding innovation system construction, high-end industrialization, and integration of global resources, with the aim of facilitating the transformation from “Made in Guangdong” to “Created by Guangdong”.**

### Keywords

**Manufacturing Industry, Innovation, Value Chain.**

### 1. Introduction

Guangdong's economy has developed rapidly after four decades of reform and opening-up. In 2017, GDP in Guangdong province reached 8,989.923 billion yuan, ranking first in the country for 29 consecutive years. Among them, the manufacturing industry accounted for 32% of economic growth, becoming the pillar industry in Guangdong. Thanks to superiority in geographical location, policies and cost, Guangdong, known as the “world factory”, undertook a large number of international industrial transfers, and vigorously developed the manufacturing industry. At present, the “third industrial revolution” continues to expand throughout the world, and the global investment and trade order are restructured. Meanwhile, China's economy steps into the “new normal” phase. Guangdong's manufacturing industry is facing both domestic and international challenges. It is urgently necessary to change the development mode. Despite the expansion of scale and efficiency, Guangdong's manufacturing industry exposes many problems, such as low-locked in global value chain, lack of key core technologies, and irrational industrial structure. Scientific and technological innovation, considered as core motivation for the optimization of industrial structure, is the driving force for the extension of the value chain to the areas with high technological content and high added value. It also drives the upgrading of product and technology and the development of emerging industries. Therefore, the important adjustments of economy development and industrial upgrading for Guangdong province is to make economic growth change into innovation-driven from investment-driven and element-driven.

A large number of existing literature shows that innovation-driven has a positive effect on industrial upgrading and the rise of global value chains. Ji Yujun and Li Chao adopted Spatial Error Model to test relationship between regional innovation and industrial upgrading based on China's provincial panel data from 2003 to 2012, and found that the positive effect of regional innovation on the industrial upgrading is significant and robust[1]. Zeng Fanhua, etc.believed that the essence of innovation driven manufacturing industry is to continuously improve the technological innovation capability of manufacturing enterprises and promote China's manufacturing industry to leap the global value chain to the high end[2]. At present, the transformation and upgrading of manufacturing industry are imperative, and the key is to firmly take the path of independent innovation.This paper analyzes the status quo and problems of innovative development of manufacturing in Guangdong

Province. Then, some suggestions on innovative development of manufacturing in Guangdong province are put forward to facilitate the transformation from “Made in Guangdong” to “Created by Guangdong”.

## 2. The Status Quo of Innovative Development of Manufacturing in Guangdong Province

### 2.1 Development of Manufacturing in Guangdong province

In recent years, with the optimization of economic structure, the promotion of industrial upgrading and the accelerated transformation of driving forces, the scale of manufacturing industry has gradually expanded. As seen in Figure 1, from 2010 to 2016, gross industrial output value of manufacturing industry has rose steadily from ¥ 7.95 trillion to ¥ 12.48 trillion. Although The scale of manufacturing continued to expand, the growth rate has shifted from high-speed growth to steady growth at a low-to-medium-speed level. While a growth rate rebound appeared in 2016. The added value of Manufacturing industry reached ¥ 2.85 trillion in 2016, seeing an increase of 7.2% year-on-year. Recently, the dual pressure of the manufacturing revitalization in developed countries and China’s economy entering the “new normal” has greatly inhibited the growth of Guangdong’s manufacturing industry. The three pillar industries that is electronic information, electrical machinery and automobile, play a key role in manufacturing development. Gross industrial output value of three pillar industries was ¥5.42 trillion, claiming over 43.42% of the provincial total. Moreover, there are 10,146 industrial enterprises above designated size, providing job to about 5.44 million people. Actually, the main reason for the rapid development of the three pillar industries is the contribution of leading enterprises. There are three Guangdong’s manufacturing enterprises on the Global Fortune 500 list in 2017, namely Huawei Technologies Co., Ltd., Guangzhou Automobile Industry Group Co., Ltd., and Zhengwei International Group Co., Ltd. What’s more, In 2017, driven by the rapid production of Huawei, VIVO, and OPPO, the Communication Equipment, Computers and Other Electronic Equipment Manufacturing contributed 42.1% of provincial above-scale industrial added value growth.

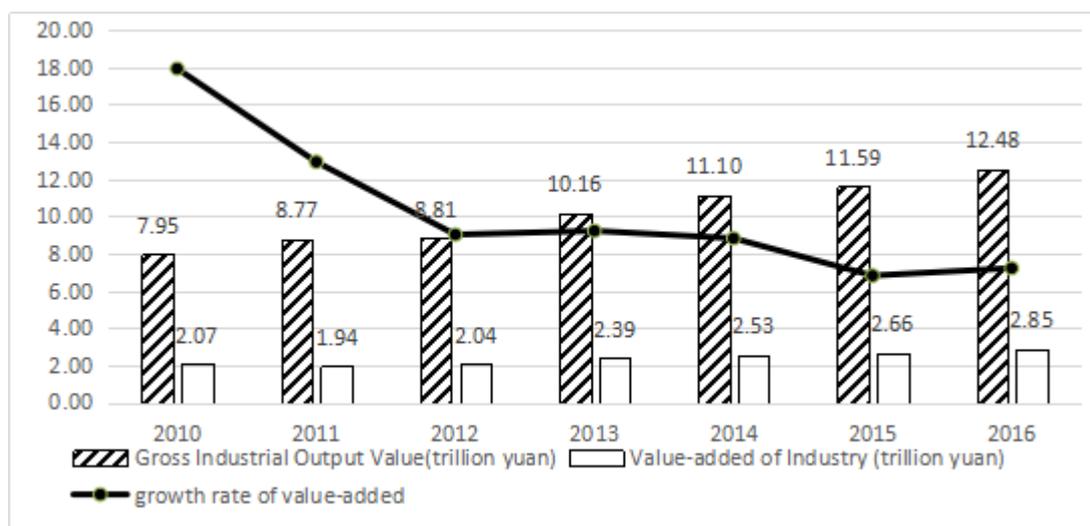


Figure 1. Development status of manufacturing industry in Guangdong between 2010 and 2016  
Source: Guangdong statistical yearbook various of years

### 2.2 The Strong Public Innovation Services Capability Boost Industry Clustering

As a powerful province both in economy and manufacturing, Guangdong has formed a number of influential and competitive manufacturing industry clusters over the past 40 years. There are emerging industrial clusters with an output value exceeding RMB 100 billion, covering new generation of mobile communications, flat panel displays, high-end software, semiconductor lighting, bio-pharmaceuticals, smart manufacturing equipment, and new materials. These industries have

developed a relatively complete modern production system with strong manufacturing capabilities. In 2017, the size of electronic information industry in Guangdong accounted for nearly one-third that of China. The value of electronic information manufacturing output exceeded ¥ 3.3 trillion, and the software and information services revenue exceeded ¥ 0.8 trillion, ranking first in the country. The number of national-level information industry bases in Guangdong ranks first in the country, including national integrated circuit design industrialization bases, national-level electronic information industry bases, national software industry bases, etc. With the close integration and coordinated development of upstream and downstream enterprises in the supply, the overall efficiency of the manufacturing industrial chain was well improved.

By 2017, Guangdong Province has established 13 national-level engineering laboratories, 23 national engineering (technical) research centers, and 66 national and local joint innovation platforms, which greatly improve Guangdong's manufacturing public innovation service capabilities. In order to meet the demands of industrial upgrading and nurturing new driver, manufacturing innovation center is built on strategic emerging industries, involving new generation of information technology, high-end equipment manufacturing, green low-carbon, bio-medicine, digital economy, new materials, marine economy. As shown in Table 1, there are 6 manufacturing innovation centers identified by Guangdong. Through government guidance and market-oriented operation, the manufacturing innovation center could realize the function of integrating industrial resources, including enterprises, research institutes, universities, and industry organizations, building key generic technology R&D platforms, getting through the innovation chain from technology development and transfer to the first commercialization.

Table 1: List of Manufacturing Innovation Center in Guangdong

| Name of Innovation Center  | Lead Time | Key R&D Areas                            | Leading Enterprise  |
|--|-----------|--|---|
| Printing and Flexible Display Innovation Center                              | June 2016 | New generation of electronic information | Guangdong Juhua Printed Display Technology Co. LTD                                |
| Robot Innovation Center  | June 2016 | Intelligent Manufacturing                | The fifth Electronic Research Institute of MIIT                                   |
| Lightweight Polymer Material Innovation Center                               | June 2016 | New material                             | KINGFA SCI.&TECH. co., ltd  |
| Marine Engineering Innovation Center   | June 2017 | Marine engineering equipment             | China International Marine Containers (Group) Co., Ltd.                           |
| Intelligent Network of Automotive Innovation Center                          | June 2017 | Intelligent network of Automotive        | Guangzhou Automobile group co. LTD  |
| Semiconductor Intelligent Equipment and System Integration Innovation Center | June 2017 | High-end Equipment Manufacturing         | Foshan Nanhai Guangdong Technology University CNC equipment Cooperation Institute |

### 2.3 Technological Innovation Drives Industrial Upgrading

Economic development in essence is a process of continuous technological and industrial innovation[3]. As an economy-developed province, Guangdong not only continue leading the national economy, but also switch its driving force to innovation. In 2017, the number of patents authorization and PCT international patent application of Guangdong ranked first in China, and the rate of R&D expenditure, the rate of technology Self-sufficiency and contributing rate of technology advancement were 2.65%, 72.5% and 58%, respectively. Furthermore, high-tech industries and advanced manufacturing industries have developed greatly, and the manufacturing industry level has gradually advanced towards the mid-to-high end. In 2017, the value added of advanced manufacturing industry was ¥1.76 trillion, increased by 10.3% year-on-year, accounting for

53.2% of the industrial growth. While the high-tech industry achieved an industrial added value of 950 billion yuan, seeing an increase of 13.2%, accounting for 28.8% of the industrial growth. Advanced manufacturing and high-tech manufacturing considered as new driving force, raised industrial growth by 5.3 and 3.7 percentage points, respectively. At present, there are 14 state-level high-tech zones, covering Shenzhen, Guangzhou, Dongguan, Zhuhai, Foshan, Zhongshan, Huizhou, Jiangmen, Zhaoqing, Qingyuan and Heyuan. Adhering to the concept of innovation and open collaboration, the High-tech Zones actively embed in the global innovation network, introducing advanced talents, integrating global innovation resources, so as to comprehensively enhances technological innovation capabilities[4]. Among them, Guangzhou and Shenzhen High-tech Zone established innovative base for overseas talents. Huizhou Hi-tech Zone created a number of overseas incubators, and Guangzhou Hi-tech Zone enterprises participated in the formulation of 64 international industrial standards, ranking third in the country.

#### **2.4 Process Innovation Improves Manufacturing Quality**

Under the new technological revolution, manufacturing industry is developing to the direction of digitalization, networking, intelligence, and servitization. With a strong industrial foundation in electronic information industry, Guangdong vigorously develops intelligent manufacturing. The transformation of manufacturing mode is promoted in robot application, intelligent transformation and green manufacturing, so as to improve the level of process innovation. In 2016, the total industrial robot output in Guangdong grew by 45.3%, and the number of newly increased robots reached 22,000. Moreover, the number of robots in Guangdong accounted for about one-fifth that of the country's total. Some regions such as Guangzhou, Shenzhen, Foshan and Dongguan built a number of competitive robot demonstration areas where robot industrial chain is formed from R&D, production to application, promoting the rapid development of industrial and special robot industries. A number of intelligent workshops was built as an industry demonstration in some key industries, such as smart phone accessories, petrochemical processing, equipment manufacturing. Through the application of robots, the productivity of key industrial projects increased by more than 20%, and upgrade cycle was shortened by an average of 30%,. Moreover, both operating costs and product defect rate were reduced by about 20% .

### **3. Issues of Innovative Development of Manufacturing in Guangdong Province**

#### **3.1 Manufacturing Industry in Guangdong is Locked in Low-end of Global Value Chain**

Guangdong has developed an export-oriented economy for a long time. With advantages of location, cost, and preferential policy, it actively undertakes international industrial transfer and integrates into system of division of labor in value chain led by the developed countries. However, most manufacturing enterprises in Guangdong are labor-intensive, engaged in processing and assembly. They seldom conduct R&D and design activities, lacking of technical accumulation and advanced production processes, which leads to exported products with low added value, low technological content, and lack of self-owned brands. What's more, multinational corporations in developed countries take advantage of technical innovation to control the market and resource and seize both ends of "Smiling Curve" in enterprise value chain. As a result, Guangdong's manufacturing industry has been at the low end of the global value chain for a long time because of technical and market blockades. Presently, with the increasing cost of labor, China's demographic dividend is diminishing gradually[5], affecting the competitive advantage of most labor-intensive industries in Guangdong. It is imperative to upgrade traditional industries. In addition, the pillar industries are in low profitability, and emerging industries are still in the ascendant, there is still a long haul ahead for Guangdong to move up the value chain.

#### **3.2 Industrial Clusters Are Large But Not Strong**

Since the reform and opening up, a large number of distinctive professional towns and industrial clusters have risen rapidly in Guangdong. By 2016, there were 440 professional towns, covering a wide range from ceramics, textiles, household appliances to petrochemical production and steel

manufacturing. It also established electronic information industry belt on the east shore of the Pearl River and equipment manufacturing industry belt on the west shore of the Pearl River. However, Guangdong's industrial clusters are large but not strong, lacking large leading companies and regional brands. What's more, they are centralized but not clustered, due to few links between upstream and downstream enterprises of supply chain and low industrial relevance. Most industrial chains still remain in the development stage of labor intensive, resource consumption and extensive management. Indeed, only the minority of clusters have sound and efficient industrial supporting chains and establish one-stop supply and marketing[6]. Most of industrial clusters are imperfect in industrial chain, inadequate in supporting facilities for public service platforms, and prominent in product homogenization among enterprises.

### 3.3 Regional R & D Investment Shows Great Imbalance

Compared to other developed countries and regions, the independent innovation ability of Guangdong has a disparity at a certain extent and exists a vast promotion room age. The total R&D expenditure Eastern, Western, and mountainous region which contribute to nearly 21% of provincial growth in 2016, were only RMB 9.294 billion, accounting for 5.5% of the provincial R&D expenditure. In the Pearl River Delta region, R&D expenditures reached 158.333 billion yuan, accounting for 94.5% of the province's total, and the highest R&D expenditure in Shenzhen was 7 times higher than that in the total of eastern, western and northern Guangdong. Shenzhen and Guangzhou respectively accounted for 45.3% and 13.8% of the province's total. Especially Huawei and ZTE occupied half of the industrial R&D investment in Shenzhen. The great imbalance in this region restricts the overall development of research and innovation in the province. In terms of transformation of scientific and technological achievements, Guangdong lacks an effective mechanism for transforming scientific and technological achievements, the ability to commercialization as well as the endogenous power of industrial development.

Weak technological innovation capabilities lead to the weak international competitiveness of Manufacturing in Guangdong. Since most of manufacturing companies have been engaged in processing for a long time, they lack capability for key technologies and equipment development, resulting in the excessive and undue dependence on imports for core components and major equipment. For example, the technology self-sufficiency rate of the robotics industry in Guangdong is relatively low. In particular, key components such as control systems, servo systems, speed reducers, and sensors rely on imports. It also lack key technologies such as robot control and drive technology, sensor technology, offline programming system, reliability technology and integration technology. 80% of Guangdong's industrial robot market, especially the automotive and electronics industries, are still occupied by foreign brands, and the competitiveness of local robots is relatively weak.

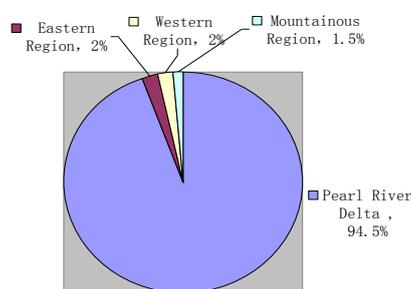


Figure 2: R&D expenditure of Guangdong's Pearl River Delta, Eastern, Western and Mountainous regions in 2016

Source: Guangdong statistic yearbook in 2016

### 3.4 The Shortage of High End Talent

With the coming of knowledge economy age and the call for accelerating globalization, talents become the first resource. As the transformation of Guangdong's manufacturing industry from traditional manufacturing to capital and technology-intensive industries, the demand for talent has

changed. Insufficient supply of talent resources has become an important factor constraining the upgrading of manufacturing. On the one hand, leading talents and skilled craftsmen is too insufficient to support the transformation and upgrading of the manufacturing industry. In 2016, there were 156 technical colleges and universities in Guangdong. However, the number of skilled workers reached 10.88 million, accounting for only 16% of the employer. The skills gap reached 183,000 in August 2017, especially in some field such as information technology industry, CNC machine tools and robots industry. On the other hand, there are some problems in Guangdong universities, such as the imbalance of regional distribution, the mismatching between talent training mode and enterprise demand, and the weakness of serving regional economic capacity. The number of undergraduate institutions in the Pearl River Delta reached 34, accounting for 80.95% that of the whole province. The universities in the east, west and north of Guangdong are not high in quantity or quality, and it is difficult for them to serve the local economic and social development. In addition, there is a lack of effective communication between schools and businesses. Universities and colleges rarely set up specialties based on the talent demand of manufacturing, lacking in-depth integration with the industry. Colleges and universities are very weak in the practice of engineering education and the efficiency of talent cultivation.

#### **4. Countermeasures on the Innovative Development of Guangdong Manufacturing Industry**

##### **4.1 Construct Collaborative Innovation Model of GIURFU**

The collaborative innovation model combines government, industries, universities, research institutes, financial institutions, and users(Figure 3). For the purpose of collaborative innovation, it gives full play to all in innovative subject's resource advantages in science and technology innovation, product innovation, talent training and funds, combining government's macro regulation and control capabilities and user' market-oriented role, so as to enhance overall technological innovation capability and promote the transfer of scientific and technological achievements. The GIURFU cooperation is the coordination and integration of functions and resources in different social divisions of labor involving Government, research, education, production, market and finance, docking and coupling upstream and downstream businesses in technology innovation chain. Therefore, it is an important way for Guangdong's manufacturing industry to enhance technological innovation capability. On the other hand, Industry-University-Research cooperative education can cultivate highly qualified personnel with innovative spirit and practical ability to ease the shortage of talents. Accelerate the establishment of a collaborative innovation system of GIURFU. Firstly, collaborative innovation platform should be built to deeply integrates various innovative entities. The collaborative innovation platform where enterprise is in dominant position makes full use of leading function of the government and market-oriented role of users. It also takes advantage of technical support from universities and research institutes and the financial support from financial institutions[7]. Secondly, the deployment of innovation chain around the industrial chain should be allocated by resource chains. It is urgent for Guangdong Province to make breakthrough in key technologies, speed up the industrialization of scientific and technological achievements, improving innovation capabilities in key areas.

##### **4.2 Optimize the Industrial Structure and Develop High-end Industry**

Locked-in low end of value chain, low proportion of high-end manufacturing, lack of R&D and brand marketing activities has been the weakness of Guangdong's manufacturing industry for a long time. The international division of labor and trade environment are changing rapidly. Meanwhile, the world is in the new stage of technological revolution and industrial revolution. In that context, manufacturing industry in Guangdong must change the previous direction and path, shifting to industrial transformation and upgrading. Promoting the high-end manufacturing industry is the key to seize the domain position of many areas in the new round of industrial revolution[8]. The traditional industry is to construct value chain based on information technology, taking value reconstruction as the core upgrade mode. Besides, it should attach importance to breaking through key links such as

R&D, standards, precision processing. The upgrading of processing, product, chain can facilitate a leap forward in the value chain. Actually, the development of high-end manufacturing depends not only on innovation in technology, production, and business models, but also on organizational and institutional innovation. Firstly, pay attention to the top-level design for the high-end manufacturing industry, especially in terms of planning guidance and mechanism innovation. Strengthening construction of modern vocational education system and information security can give a firm guarantee for the development of high-end manufacturing industry. Secondly, improve the high-end industrial policy support system, special in terms of financial resources, tax incentives. Government could encourage high-tech enterprises to increase investment in technology research and development, technological innovation, and new product promotion. Thirdly, create a good environment for innovation and entrepreneurship. It is important to build perfect platform and service system for innovation and entrepreneurship around the industrial chain, innovation chain and capital chain.

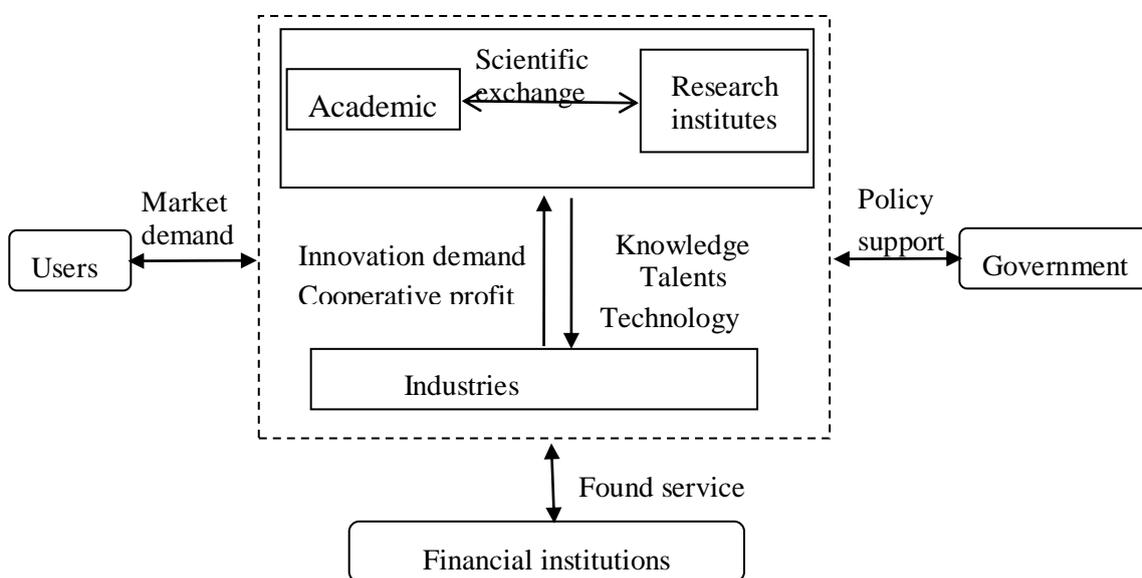


Figure 3: Collaborative Innovation Model of GIURFU

#### 4.3 Embed in the Global Innovation Network

With the globalization of science and technology activities, the cross-border flow of innovation resources is accelerating, and R&D internationalization and transnational technology transfer become new trend[9]. By establishing R&D branches around the world, companies seek and acquire new technologies to enhance their R&D capabilities. Following the trend of international industrial technology, Guangdong can realize technological leapfrogging and improve its independent innovation ability by introducing international innovative resources, including infrastructure, equipment and other tangible resources, as well as intangible resources such as scientific research personnel, institutions and intellectual property rights. With the advantages of huge market, abundant capital, and strong industrialization capability, Guangdong can introduce multiform overseas patent with multiple channels and speed up its incubation to support the development of emerging industries. First, encourage companies to acquire and establish R&D institutions oversea[10]. Companies ought to actively conduct foreign scientific and technological cooperation and exchange, introducing technology and talents from overseas developed countries and regions. Second, build an overseas resource agglomeration platform with international influence, like co-built industrial parks, international scientific and technological cooperation platforms, or various incubators at home and abroad. Relying on these platforms to embed the global innovation network, the top R&D teams and international leading technologies can be gathered to achieve effective docking of patent outcome

projects. Third, create a legal business environment with a focus on the protection of intellectual property rights. Government should establish sound administrative enforcement system for intellectual property right, with management model that combines patents, trademarks and copyright to strengthen the protection of intellectual property rights.

#### 4.4 Deepen the Integration of Manufacturing Industry and Internet

Internet technology has been gradually applied to all aspects of manufacturing and the entire product cycle. New modes and new formats continue to emerge, reshaping industrial organizations and manufacturing models. "Internet plus" model characterized by networking, intelligence, servitization, and collaboration can drive processing innovation. The integration of intelligent networks and the industrial revolution can effectively organize the manufacturing industry. It can make real-time interaction between enterprises and equipment and people in the workplace, and realize market information interconnection to precise match demand and supply. Through the integration of manufacturing resources and the establishment of flexible production systems, smart factories optimize resource allocation and greatly increase productivity. On the other hand, with the rapid development of the Internet, many new sales channels have emerged, making it easier for manufacturing companies to innovate their business models. It is convenient for companies to reduce the intermediate links of transactions, and expand their domestic and overseas marketing networks. The convergence of internet and manufacturing industry can speed up transformation of industrialization and informatization in manufacturing industry. Enterprise are to extensively use next-generation information technologies such as Internet of things, cloud computing, and big data, in service sector involving R&D, management, branding and marketing, which result in further integration of manufacturing and producer services. Furthermore, It can help companies create new models for smart industries and promote the building of a powerful province in Guangdong .

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