Geography

Learning and Teaching Resources on Guangdong-Hong Kong-Macao Greater Bay Area (Greater Bay Area)

Industrial Development in the Greater Bay Area

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Personal, Social and Humanities Education Section, Curriculum Development Institute, Education Bureau

January 2022

1 Introduction

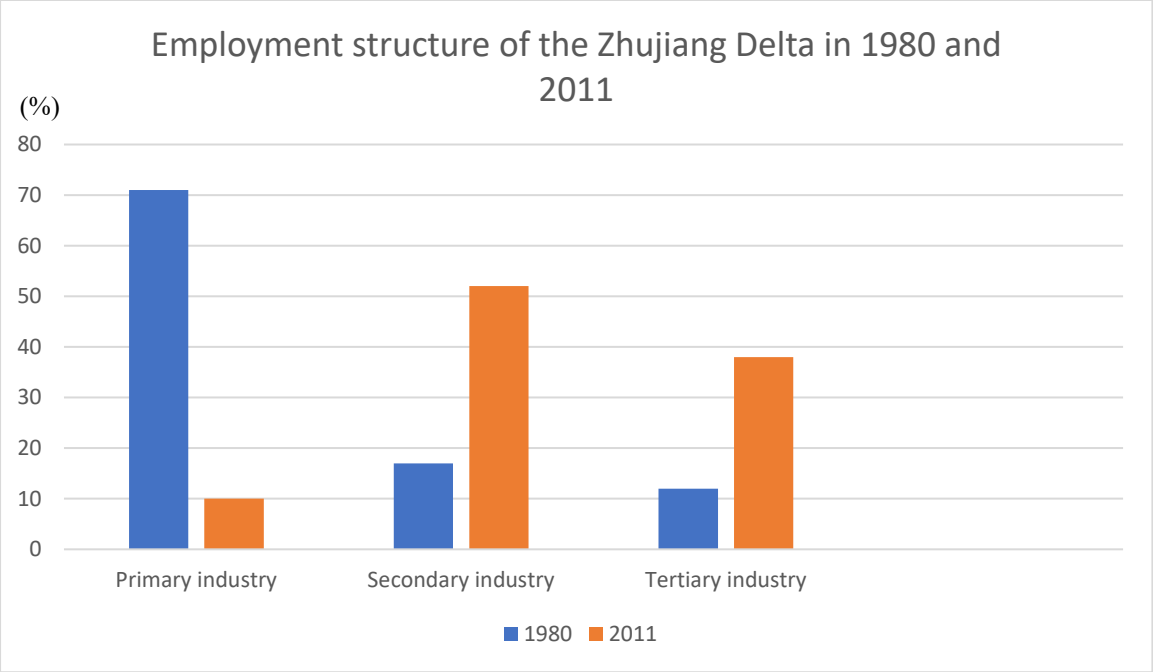
The industrial activities in the Guangdong Province are mainly concentrated in the southern part of the Zhujiang Delta region[1] where the Guangdong-Hong Kong-Macao Greater Bay Area (Greater Bay Area) is located. With huge foreign investment, the industrial development in the Zhujiang Delta began in the 1980s. The success of the "front-shop-and-back-factory" model transformed the Greater Bay Area from a weak industrial base to an industry-led region. Since the 1990s, the Zhujiang Delta region has once again grasped the opportunities brought about by the production restructuring and transformation, and hence it has become an important heavy industry base of our country. In the 21st century, with the rapid development of the industrial economy, many enterprises in the Zhujiang Delta increase their investment in industrial technology in order to seek faster economic development and reduce dependence upon foreign capital. These enterprises start their own research and development and develop their own brands. In the era of "Industry 4.0", the industrial activities in the Zhujiang Delta region are moving forward to high-end and "smart" manufacturing, with the help of the national policies.

2 Background of industrial development in the Zhujiang Delta region of the Greater Bay Area

Before the 1980s, the Zhujiang Delta region had always been an area dominated by agriculture. Most of the local people were engaged in agricultural activities such as farming and livestock rearing. With the reform and opening up since 1978, the industries in the Zhujiang Delta region had rapidly developed, and hence led to rapid industrialisation and urbanisation (see Figure 1).

[1] Zhujiang is the largest river in South China. It consists of three main tributaries and other tributaries of the Xijiang, Beijiang, and Dongjiang. The transport materials of these tributaries are carried by the river water to the estuary (Zhujiang Estuary) and deposited at the estuary to form a fertile delta called the "Zhujiang Delta". After the reform and opening up, the Guangdong Provincial Government designated Guangzhou, Shenzhen, Dongguan, Foshan, Jiangmen, Zhongshan, Zhuhai, and the urban areas of Huizhou and Zhaoqing in the Zhujiang Delta as the Zhujiang Delta Economic Zone, which became the prior regions of the country's reform and opening up. On this basis, Hong Kong and Macao Special Administrative Regions were added to extend the concept of the "Greater Zhujiang Delta Region".

Figure 1: Employment structure of the Zhujiang Delta in 1980 and 2011



Source: Statistics of Guangdong Province (2019); Directorate-General of Budget Accounting and Statistics, Executive Yuan (2019); Hong Kong Census and Statistics Department (2019)

The following shows the main reasons for the rapid industrial development in the Zhujiang Delta region:

(1) **Government policy**: In order to promote international trade, the Chinese Government opened up four coastal cities[2] in Guangdong and Fujian Provinces as special economic zones after 1978, including Shenzhen and Zhuhai in the Greater Bay Area. As a special economic zone, the government can formulate its own economic policies such as trade, foreign exchange and land grants. The government had also formulated a series of preferential policies, such as a profit tax rate as low as 15%, a tax exemption period of up to 5 years, preferential land prices and duty-free tariffs on raw materials and semi-finished products, and these had successfully attracted a large number of overseas investors to set up their factories in the area.

(2) **Proximity to Hong Kong and Macao**: With the proximity to the Zhujiang Delta region, Hong Kong and Macao are important sources of capital for the industrial development in the

2 **Four coastal cities** served as special economic zones: include Shenzhen, Zhuhai, Shantou and Xiamen.

area. In addition to providing capital, the investors from Hong Kong and Macao also brought advanced industrial processes and business management skills to the Zhujiang Delta region. As a result, the manufacturing in the Zhujiang Delta region had developed rapidly.

(3) **Cheap labour**: The traditional manufacturing in the Zhujiang Delta was dominated by labour-intensive industries which labour costs accounted for a large proportion. Compared with Taiwan and Hong Kong, a large quantity of cheap labour in the Zhujiang Delta was an important factor for overseas investors to set up their factories there (see Table 1).

Table 1: Mean monthly salary of workers in various industries in the Zhujiang Delta region, Taiwan and Hong Kong (HK$)

Industry	Zhujiang Delta region	Taiwan	Hong Kong
Food processing	$3,646	$9,909	$9,200
Clothing	$2,558	$8,740	$12,500
Printing	$3,676	$9,208	
Electronic	$3,407	$11,721	
Medicine	$3,661	$9,842	

Source: Statistics of Guangdong Province (2019), Directorate-General of Budget, Accounting and Statistics, Executive Yuan, R.O.C. (Taiwan) (2019), Census and Statistics Department, The Government of HKSAR (2019)

(4) **Comprehensive transport networks**: Industrial development relies on comprehensive transport networks to transport the raw materials and export the finished products. Since the 1980s, the Zhujiang Delta region has been actively improving sea, land and air transport.

(5) **Agglomeration economies**: When the industrial activities gather at a certain location, the enterprises in the area can enjoy agglomeration economies which reduces the production costs. For example, when the enterprises producing similar products are clustered in the same area, bulk purchase of raw materials can obtain larger discounts and save costs. In addition, when related industries are clustered in the same area, the suppliers can save the distribution cost while the buyers can save the transport cost of raw materials. For example, garment factories and needlework factories are usually built near textile mills and this can save the transport and

distribution costs. In the 1980s, each industrial town in the Zhujiang Delta region developed their own specialised industries so as to enable their factories to share the economic benefits brought about by agglomeration.

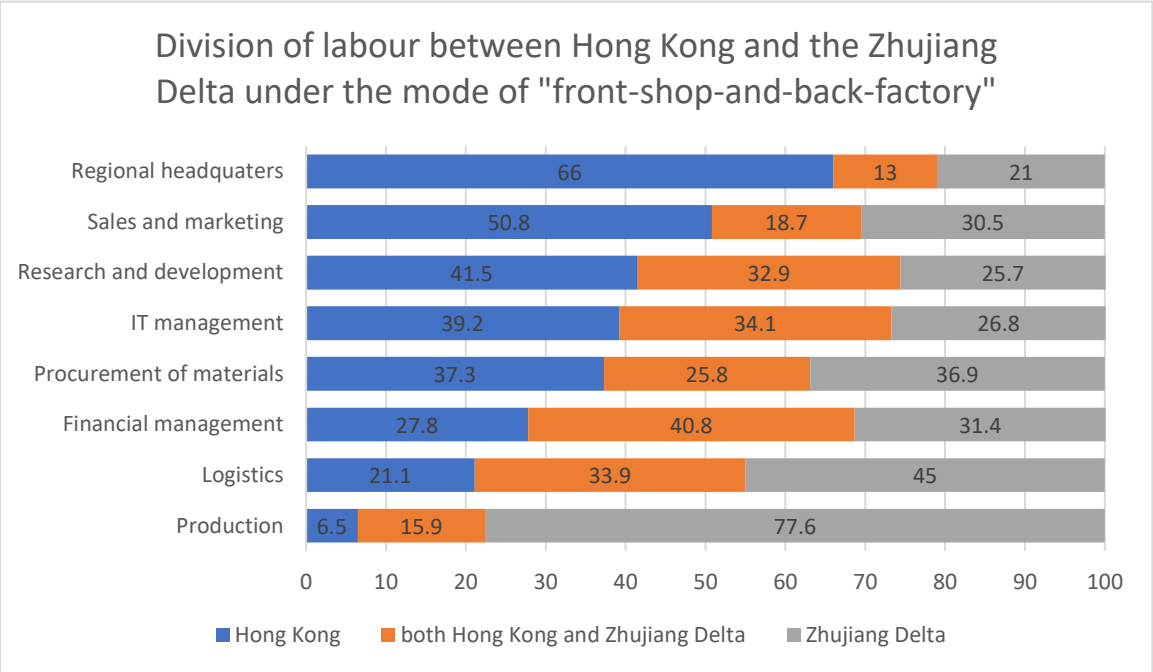
(6) **Broad local and overseas markets**: As China is the most populous country in the world, it has the highest demand for various commodities, and this forms a huge domestic market for the industrial goods in the Zhujiang Delta region. In addition, compared with the other areas in the world, both land rent and labour costs were low in the Zhujiang Delta region. Together with the high-quality products, the products had certain competitiveness in the global market.

3 Characteristics of manufacturing industries in the Greater Bay Area

3.1 The production mode of "front-shop-and-back-factory"

Since the industrial development of the Zhujiang Delta region in 1979, Hong Kong and the Zhujiang Delta region have successfully collaborated in the development of the mode of "front-shop-and-back-factory". Under this mode of production, the Hong Kong enterprises relocated their factories to the eastern part of the Zhujiang Delta, but remained the headquarters in Hong Kong, making full use of the advantages of the two places. The mode of "front-shop-and-back-factory" is a geographical division of labour. Due to the high land rent and labour costs in Hong Kong, the headquarters of the industrial enterprises generally operated as small and medium-sized enterprises, and only employed few employees for administration, finance and operational management. The factories were established in the Zhujiang Delta region, and thousands of labourers were employed for production work such as processing and assembly (see Figure 2). Afterwards, the industrial products would be shipped to Hong Kong and overseas markets for sale. Under this mode of production, this world factory created a lot of value-added exports and job opportunities for the Zhujiang Delta region, making the area one of the most economically developed areas in our country. In the meantime, this huge world factory also needs the support of massive productive services during the production process. This stimulated the development of modern financial services, trade services, logistics and business services in Hong Kong, turning Hong Kong into a world-class service industrial hub.

Figure 2: Division of labour between Hong Kong and the Zhujiang Delta under the mode of "front-shop-and-back-factory"



Source: Federation of Hong Kong Industries (2019)

3.2 From labour-intensive to capital-intensive

Due to the abundant and cheap labour supply, the Zhujiang Delta region was once a famous world factory for labour-intensive industries such as garments and electronic products. However, due to the economic development and changes in social environment, the Zhujiang Delta region was facing serious labour shortage[3]. Many processing plants were unable to operate or even closed down due to difficulties in recruiting workers. In order to solve the problem of labour shortage, some enterprises began to use machines to replace manpower and to implement automated production. This not only reduced the dependence upon labour, but also improved the productivity and product quality. However, as the introduction of automation and computerisation requires huge capital, small firms may not be able to afford it. Therefore, at this stage of development, many small processing plants in the Zhujiang Delta have been

[3] **Major causes of labour shortage:** (1) In order to improve the construction of western China, the Chinese Government implemented the Western Development Strategy in 2000 to encourage the industries to move to inland. The economic and industrial development in western China brought a large number of job opportunities to the local people. The people no longer had to leave their hometowns to work in the Zhujiang Delta region; (2) Low remuneration: The workers in the Zhujiang Delta region generally received low salaries that the average salary of the foreign workers was approximately RMB 2,000 in 2012.

eliminated while some large processing enterprises have gradually used machines in the production process instead. Although the introduction of automation programs requires a lot of capital and time (3-5 years), it can be used for a long time and brings long-term benefits to the enterprises by reducing production and operating costs.

In around 2000, the Guangdong Government also actively developed capital-intensive industries so as to restructure and increase the output value of the secondary production (manufacturing). Most of these capital-intensive industries are heavy industries such as automobile and petrochemicals industries. Attracted by the preferential policies such as tax reduction, the Guangqi Honda, which was established by Guangzhou Automobile and Honda, started its production in Guangzhou in 1998. Other Japanese automobile enterprises (such as Toyota) also set up their factories in Guangzhou. After ten years of development, Guangzhou, which clustered the production, sales, accessories and after-sales service of automobiles, became one of the most important automobile production sites in our country. The rapid development of the heavy industry in the Zhujiang Delta region has laid a solid foundation for the future development of machine manufacturing, bio-pharmaceuticals and software industry. This undoubtedly enhanced the overall competitiveness of the Zhujiang Delta region.

3.3 From original equipment manufacturer (OEM) to original design manufacturer (ODM)

The industry in the Zhujiang Delta region had just started in the early 1980s. Most of the enterprises adopted the mode of "Three Import and Compensation Trade" (i.e. processing with supplied materials, assembly with supplied parts and processing in accordance with supplied samples) which was based on the original equipment manufacturer (OEM) model for production. Under this production model, the foreign enterprises supplied raw materials, parts and machines to the factories in the Zhujiang Delta while the companies in the Zhujiang Delta was only responsible for processing and assembly. The finished products would be exported to overseas markets via the foreign enterprises, instead of for domestic sales.

In the early stage of industrial development, this model could reach a win-win situation for both sides. On the one hand, the foreign enterprises could make use of massive cheap labourers

in the Zhujiang Delta for production, and this helped save the production costs and thereby increase profits. On the other hand, this model could provide huge employment opportunities for the Zhujiang Delta region and promote the rapid development of the regional economy. This mode of production accounted for more than half of the exports in the Zhujiang Delta from 1995 to 2007. However, it began to experience a sharp decline after 2007, mainly due to the over-reliance on the foreign capital, markets and technology of the OEM model. When the orders from overseas markets reduced or the overseas technology could not be timely supported, the operations of the factories in the Zhujiang Delta region would become difficult. In addition, the finished products were not allowed to be sold domestically under the OEM model. Therefore, the factories could only earn a limited processing fee, and the marginal profit obtained by the factories were very limited (see Figure 3). Its contribution to GDP of the Zhujiang Delta was also limited. Therefore, in the mid-era of the industrial development, many entrepreneurs began to develop and build their own brands, changing the production model from OEM to original design and manufacturer (ODM) and the original brand manufacturer (OBM).

Figure 3: The value added of different production procedures

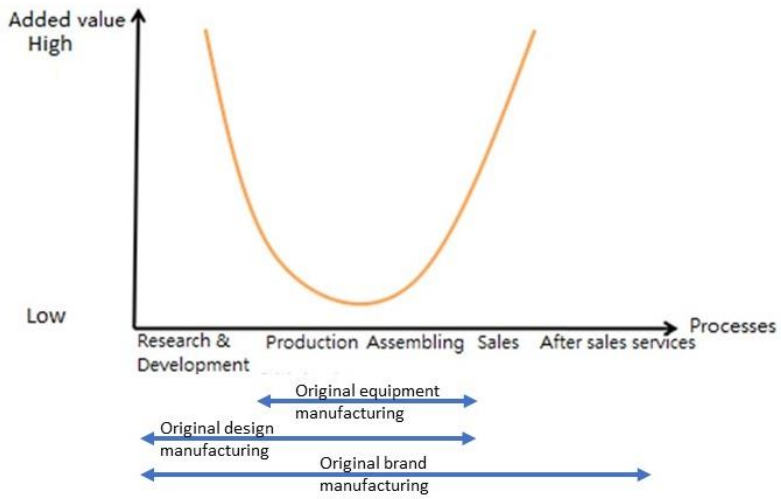


Table 2: Comparisons of different modes of production

	Original equipment manufacturer (OEM)	Original design manufacturer (ODM)	Original brand manufacturer (OBM)
Branding	Foreign brands	Foreign brands	Local brands developed by Chinese enterprises
Product design	by foreign enterprises	by Chinese enterprises	by Chinese enterprises
Production	by Chinese companies		
Product sales	Overseas markets	Overseas markets	Local and overseas markets

Unlike the OEM model, the enterprises adopting the OBM model need to invest huge capital to hire scientific research personnel for research and development as well as build various infrastructure and facilities. By enriching the knowledge and technology needed for production, the enterprises can carry out manufacturing upgrades and build their own brands, reducing the dependence upon foreign enterprises. The Midea Group, which was established in Foshan in 1968, was the best example of the successful transformation of the enterprises from OEM model to OBM model. The Midea Group is currently one of the largest home appliance manufacturers in our country. In the early 1980s, the Midea Group mainly processed and assembled electric fans for foreign enterprises. After accumulating certain experience, the Midea Group upgraded its production structure and abandoned the OEM model while it began to produce its own electric fans. In 1985, after a certain amount of capital accumulation, the Midea Group began to produce air conditioners and invest in air-conditioning technology. With the gradual expansion of the enterprise, the Midea Group started to pay attention to the research and development in 1998, and successfully made breakthroughs in inverter and wafer production technology with Toshiba. Up to this moment, the Midea Group has developed thousands of home appliances such as air conditioners, rice cookers and washing machines, and these products are widely sold in the Mainland, Japan and the United States.

3.4 From low technology to high technology

3.4.1 Transformation of traditional industries

In recent years, the economy of the Zhujiang Delta region in the Greater Bay Area has rapidly developed, and the gap between the Zhujiang Delta region and Hong Kong has been shrinking. The development model of the "front-shop-and-back-factory" has been challenged. In order to enhance competitiveness and make good use of human resources, the Guangdong Government began to implement transformation policies in 2008, including production and labour transformation. In terms of production transformation, the government moved the high-pollution and high-energy-consuming traditional manufacturing industries to the mountainous areas in the eastern, western and northern parts of Guangdong Province, thereby improving the functional level of the Zhujiang Delta region and optimising the production structure. After relocating the traditional industries to relatively backward areas in Guangdong Province, the local people were transferred from primary industry (agriculture) to secondary and tertiary industries. In the meantime, the government also encouraged high-quality workers in these areas to migrate to the Zhujiang Delta, and engage in high-growth and high-value-added industries to increase human resources and improve the labour quality.

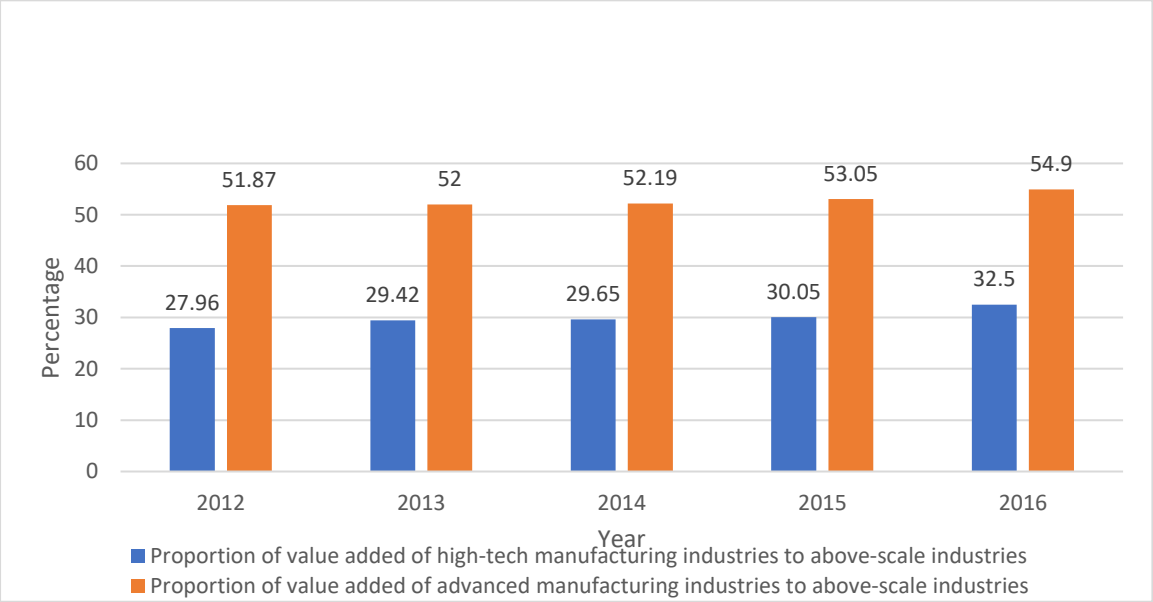
3.4.2 Adjustment of the internal structure of manufacturing

As traditional industries gradually moved out from the major cities of the Greater Bay Area, the government has begun to develop advanced manufacturing and modern service industries in recent years. In order to promote the upgrading of the manufacturing, the government has invested a large amount of resources to encourage the development of high value-added and high-tech industries[4] to increase the proportion of medium and high-end manufacturing in the production structure. In 2016, the proportion of the advanced manufacturing and high-tech manufacturing in the nine Mainland cities of the Greater Bay Area accounted for 54.9% and 32.5% of the value added of above-scale industries [5] respectively (see Figure 4), which

[4] **High value-added and high tech-industries:** For example, biopharmaceutical industry, automobile industry and information technology industry.
[5] **Above-scale industries**: Refers to industrial enterprises with annual business income of RMB 20 million and above.

increased by 3% and 4.5% respectively compared with 2012. There are booming development of strategic new industries such as new generation of mobile communication devices, new tablet computers and new energy, accounting for 22.2% of the above-scale industries. From the characteristics of high-end manufacturing[6], the electronics and communication device manufacturing industry has developed rapidly and dominated (see Figure 5) the high-tech manufacturing industry. Among the advanced manufacturing industries, automobile industry, chemical raw material and products manufacturing remain their major positions of advanced manufacturing (see Figure 6).

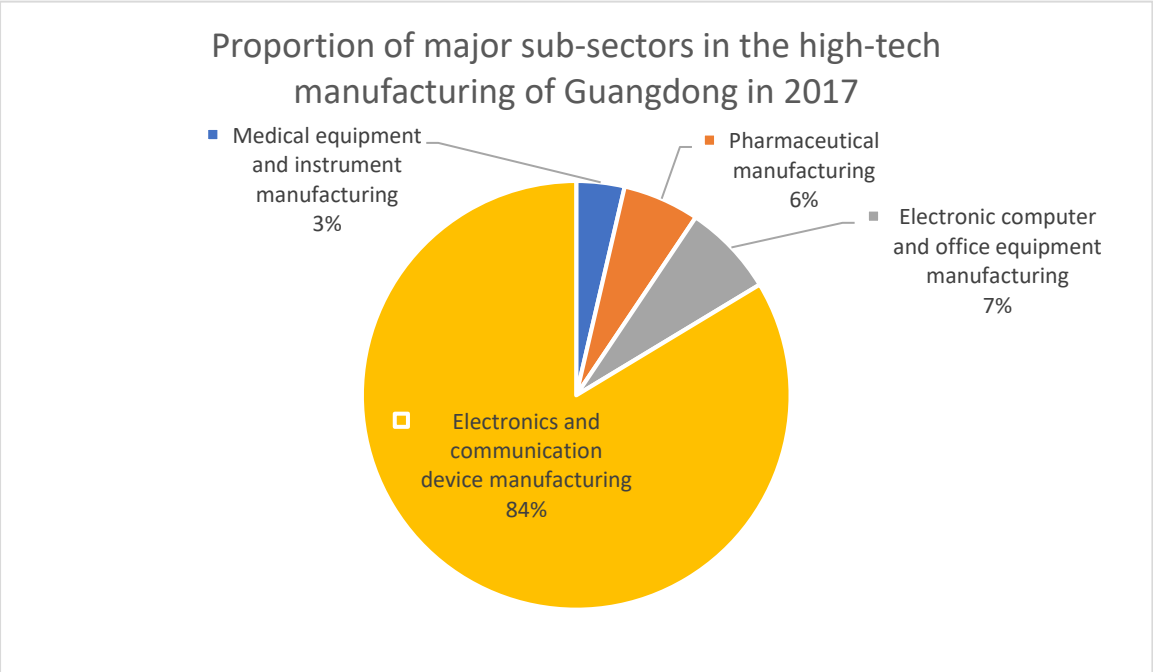
Figure 4: The proportion of value added by advanced and high-tech manufacturing industries in the nine Mainland cities of the Greater Bay Area to the above-scale industries.



Source: Statistics of Guangdong Province (2019)

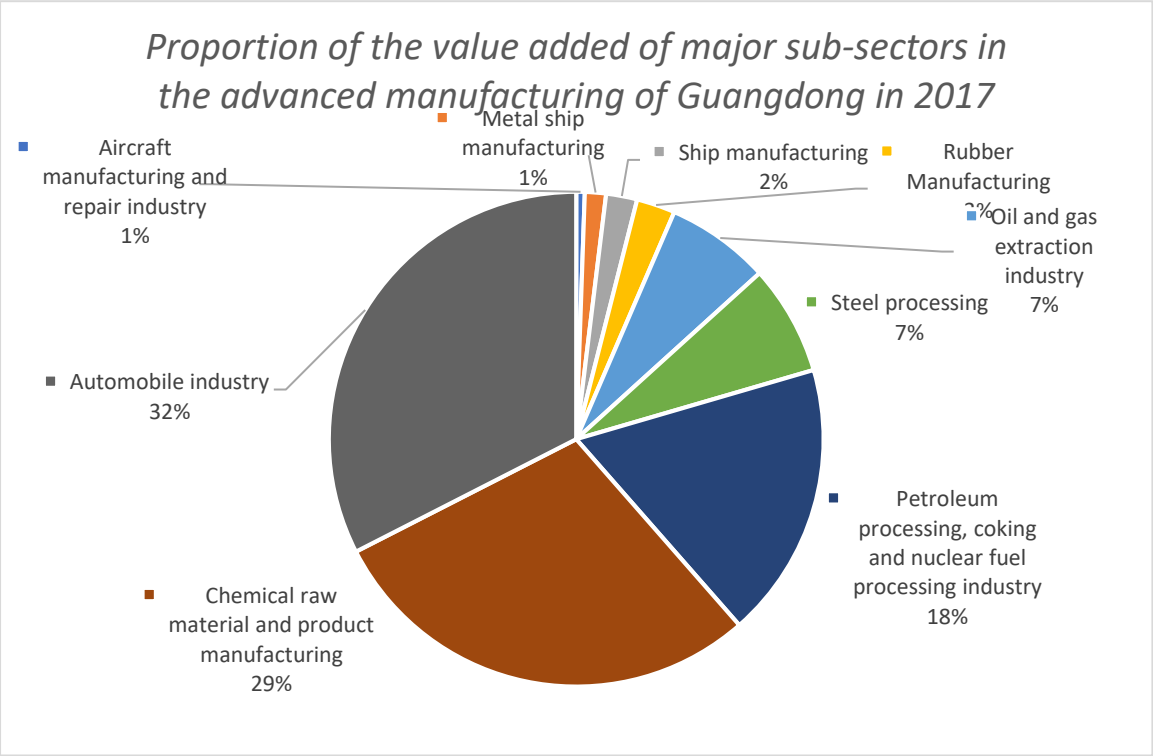
[6] **Characteristics of high-end manufacturing:** As the value added of the manufacturing industries in the nine Mainland cities of the Greater Bay Area accounts for approximately 80% of that in Guangdong Province, the manufacturing data of Guangdong Province can basically represent the manufacturing performance of the nine Mainland cities in the Greater Bay Area.

Figure 5: Proportion of major sub-sectors in the high-tech manufacturing of Guangdong in 2017



Source: Statistics of Guangdong Province (2019)

Figure 6: Proportion of the value added of major sub-sectors in the advanced manufacturing of Guangdong in 2017



Source: Statistics of Guangdong Province (2019)

Currently, the nine Mainland cities of the Greater Bay Area have become the largest high-tech industrial production bases in our country. The development of high-tech industries is inseparable from research and development and innovation. In the past ten years, the governments of the Mainland cities in the Greater Bay Area have continued to increase investment in scientific research. In order to encourage high-quality innovative talents and enterprises to relocate to the Greater Bay Area, the governments have adopted a series of policies, including:

- provision of research funds (e.g. The Shenzhen Government invested a total of RMB 80 billion in research in 2017, accounting for approximately 4% of its GDP)
- Improvement of support facilities (e.g. building high-tech industrial parks and national supercomputer centres)
- Recruitment of talents globally (e.g. The Guangzhou Government conducts career fairs in the United States, United Kingdom and Australia in order to attract talents; the Shenzhen

Government provides one-off subsidies for undergraduates who move to Shenzhen as residents)

- Close cooperation with Hong Kong (e.g. establishment of Qianhai Shenzhen-Hong Kong Modern Service Industry Cooperation Zone to strengthen scientific and technological cooperation between the two cities)

In accordance with the *Guangdong-Hong Kong-Macao Greater Bay Area Synergy Innovation Development Report (2017)*, there are currently 1 national innovation demonstration zone, 3 national innovation cities (see Table 3) and 193,712 invention patent (2016) in the Greater Bay Area. The contribution rate of scientific and technological progress in Guangzhou, Shenzhen and Dongguan remained above 60% while the role of science and technology in promoting the economic development has become increasingly prominent. In 2017, the Guangzhou-Shenzhen science and technology innovation corridor created a national GDP of 6% (RMB 4.6 trillion) with a land area of 0.1% of the country. In the future, the vigorous industrial environment in the Greater Bay Area will accelerate the development of many advanced technologies. In turn, it will continue to promote the upgrading of the industries in the Greater Bay Area, and form a globally benign interaction with innovative resources. In accordance with the *Guangzhou-Shenzhen Innovation Corridor Masterplan* issued by the Guangdong Province in 2017, relying on 37 innovation nodes such as Guangzhou Higher Education Mega Centre, Dongguan Binhaiwan Bay Area, Qianhai Shenzhen-Hong Kong Modern Service Industry Cooperation Zone, the number of patent applications of PCT in the area will reach 37,000 by 2030. The proportion of value added of the high-tech industries to the value added of above-scale industries will increase to 75% of the total while the number of national high-tech enterprises will reach 45,000. The coverage of R&D institutions of the enterprises will also reach 100%. (See Table 4).

Table 3: Major achievements in science and technology innovation in the Greater Bay Area

Major achievements	Quantity
National innovation demonstration zone	1
National innovation cities	3
State key laboratories	25
National Engineering Research Centres	25
New research institutions	97
Incubators for science and technology	449
Double-employed academicians	150
Talents under the *Thousand Talents Program*	161
Innovative R&D teams under *The Pearl River Talent Recruitment Program*	112

Table 4: Index value of the Guangzhou-Shenzhen science and technology innovation corridor in 2016, 2020 and 2030

Name of index	Index value of 2016	Index value of 2020	Index value of 2030
R&D/GDP (%)	3.19	≧3.5	≧4
Contribution rate of scientific and technological progress	≧60	≧62	≧65
Number of innovation patents per ten thousand people	39.99	55	85
Number of patent application of PCT	22,167	30,000	37,000
Proportion of the value added of high-tech manufacturing to the total value added of above-scale industries (%)	43.2	53	75
Proportion of the output value of high-tech products to the total value added of above-scale industries (%)	55.51	60	70
Proportion of R&D expenses of above-scale industries for new products to the main business income (%)	1.92	2.2	4
Number of national high-tech enterprises	14,805	28,000	45,000
Coverage rate of R&D institutions of the above-scale industries (%)	30.95	60	100

Source: Guangzhou Daily Data & Digit Institute (2017)

3.5 From traditional manufacturing to intelligent manufacturing

Today's manufacturing faces many challenges, including equipment monitoring, data acquisition, quality traceability and transparent management, but the development of intelligent manufacturing will effectively solve these problems. As intelligent manufacturing has higher value added and contribution rate to the economy, it has been a key development project in the

industrial field of various countries. As the most active area in the development of artificial intelligence (AI) and big data in our country, the Greater Bay Area is an important area for the future intelligent manufacturing. Currently, the Central Government is vigorously promoting "Made in China 2025", the focus of which is to promote China's manufacturing to industry 4.0[7], and promote the development of smart factories and intelligent manufacturing. In recent years, the Greater Bay Area has continuously accelerated the smart development of manufacturing and promoted the deep integration of the new generation of information technology and manufacturing. At present, a large number of manufacturing enterprises in the Zhujiang Delta region, such as the factories in the industrial parks in Zhuhai, have begun to develop smart factories and use machines to replace manpower. On the one hand, the smart factories can effectively help the enterprises tackle the problem of labour shortage. On the other hand, machines have replaced many simple and high-risk jobs, and manpower is "transferred" to other more valuable work. However, the significance of the advanced and smart factories is not only associated with automated production by replacing manpower with machines or industrial robots, but in the era of Industry 4.0, intelligent manufacturing can also achieve the seamless connection of the materials, information and services with the internet. This can be reflected in the following aspects: (1) intelligent manufacturing can carry out intelligent analysis and tracking of the production information so as to enhance the productivity and improve the management of manufacturing; (2) intelligent manufacturing can collect comprehensive data in real time during the production process so as to enhance the immediate control of product quality as well as facilitate the post-analysis and continuous improvement work; (3) intelligent manufacturing can collect relevant information on its own during the production process, and provide real-time information needed for management personnel at all levels; (4) intelligent manufacturing can share the data collected in real time with the supervision or management departments, effectively eliminating the black-box operation in the production process and achieving full transparency of production.

In the Greater Bay Area, the era of "Industry 4.0" does not mean that less labour is needed or

[7] **Industry 4.0:** In the next decade, the fourth industrial revolution will enter the new era of "decentralised" production. The industry 4.0 can achieve real-time management of industrial production by network technologies. Industry 1.0 refers to the first industrial revolution started in the United Kingdom from late 18th century to mid-19th century. The result of this industrial revolution was to replace the manual labour with industrial machines, and this caused the socio-economy to transform from agriculture and handicrafts to the industrial economies driven by machinery. Industry 2.0 occurred in the early 20th century. This industrial revolution brought the industrial production into the stage of production lines. A new model of mass production was created through the successful separation of parts production and product transfer. Industry 3.0, i.e. the third industrial revolution, began with the highly automated production processes that occurred during the second industrial revolution. Since then, the manpower was gradually replaced by the machinery.

more industrial workers will be unemployed. The emphasis of intelligent manufacturing is not simply replacing manpower with machines, but where only machines are more efficient than humans, or using industrial robots to replace the jobs that are simple, repetitive or high-risk. When the industrial enterprises introduce robots for production, the efficiency and profits of enterprises will be greatly improved. Some enterprises will start to expand or introduce new machines for production on the basis of the original industries. These will not lead to unemployment of the original workers, but can facilitate the transfer of "idle workers" to other jobs. For example, some workers can become engineers who operate robots in the expanded enterprise after training. Table 5 shows the differences between traditional manufacturing and intelligent manufacturing.

Table 5: Transformation from traditional manufacturing to intelligent manufacturing

Traditional manufacturing	Intelligent manufacturing
Semi-automation	Automated machines
High labour costs	Industrial robot
Speeding up production process	Mechanical arms
Slow market response	Precision moulds
Production lines	Intelligent AGV
Low level of informatisation	Computer numerical control (CNC)

4 Conclusion

Driven by government policies, the Zhujiang Delta region in the Greater Bay Area started industrial development by using the OEM model in the 1980s. Up to now, the Zhujiang Delta region has become an important manufacturing centre in our country and the world. There are strong industrial base and comprehensive industrial chain. However, there are also problems such as relatively low industrial level as well as low professional and technical standard. Since the Zhujiang Delta region started with industries using the OEM model, the modern service industry in the area started late and the development level is low, which is not compatible with the transformation and upgrading of manufacturing industry. On the other hand, the manufacturing industry of Hong Kong only accounts for approximately 7% of the production. However, Hong Kong has ample experience in R&D, business management and overseas operations, and its modern service industry is at the leading position in the world. Both Zhujiang Delta region and Hong Kong have completed the industrial production model of

“front-shop-and-back-factory”. In the future, if the Zhujiang Delta region strengthens the cooperation and division of labour with Hong Kong and Macao, complementary advantages can be achieved in the service industries. The collaboration and cooperation in intelligent manufacturing can also help foster the industrial chain and value chain.

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