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Market Report:

Advanced Manufacturing in China

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Executive Summary

The manufacturing industry in China continues to develop rapidly, and its manufacturing added value ranks the first in the world. In 2018, China's manufacturing value-added rate was 21.17% of the world's total. China is expected to continue to play an important role in the world stage of manufacturing in the future, and Israeli technologies can take part in this industrial power evolution.

The national strategy "Made in China 2025" is an action plan for the first decade of the Chinese government's manufacturing strategy. In order to reach the strategic goal for China of becoming a strong manufacturing power, three steps have been set for the whole plan. By 2025, China is planning to join the world's manufacturing powerhouse ranks; by 2035, China's manufacturing industry as a whole should reach the middle level of the world's manufacturing powers, and; by the year of 2049, China's comprehensive strength will enter into the forefront of world manufacturing powers.

With that, ten key areas have been marked for industrial improvement by the government: New generation of information technology, High-end CNC machine tools and robots, Aerospace equipment, Marine engineering equipment and high-tech ships, Advanced rail transit equipment, New energy automobiles, Electric equipment, Agricultural machinery and equipment, Biomedicine and high-performance medical devices and New materials. In addition, four main indicators were set to understand how the government guide and promote the implementation of the plan: innovation ability, quality and efficiency, integration of IT with industries and green development are the main measurements.

According to 2019 statistics, Guangdong, Jiangsu, Zhejiang and Shandong are the four major industrial provinces in China's economy. Referring to cities, the top 10 cities for industrial added value in 2019 were Shenzhen, Shanghai, Suzhou, Tianjin, Chongqing, Chengdu, Guangzhou, Wuhan, Wuxi and Ningbo, respectively.[1]

At sectorial level, the smart manufacturing industry chain is covering intelligent equipment, industrial Internet, industrial software, etc. Among smart manufacturing equipment, industrial robot, high-grade CNC machines, 3D printing and intelligent devices, seem to be nowadays most attractive technologies. In addition, intelligent service products are also vital, with smart logistics, and intelligent detection becoming a trend. Furthermore, sensors, industrial software and big data centers, have been given priority to be further developed.

[1] In the region that Beijing Trade Office covers, the top four industrial provinces are Shandong, Henan, Hubei and Hebei, and the leading cities are Beijing, Tianjin, Zhengzhou and Changsha, who are among the top 20 cities in terms of industrial added value.

There are many major players in the Chinese smart manufacturing field, both in the public and the private sectors. From government level, the State Council issues a series of strategic policies, which are providing a powerful system support for Smart Manufacturing development. In addition, Ministry of Industry and Information Technology (MIIT), and the National Development and Reform Commission (NDRC) also play key roles in supporting smart manufacturing. Consequently, provincial and city level governments issue policies, to support local development of Smart Manufacturing in their territories.

Looking at the companies' level, according to analysis of the 2019 list of China's top 500 manufacturing companies, heavy chemical industry occupies a dominant position in China's industrial output.[2] As follows, the telecommunications equipment sector has movd into the top five for total profits, e.g. Huawei and Lenovo Group. In addition, automotive companies also should be paid attention: among the top 25 list, 6 are from automotive sector.[3]Consumer electronics companies, as Haier group and Midea Group, are also ranked within top 25 list.

Another group of important players are Smart Manufacturing related associations and organizations. At national and local levels, major associations and organizations related with smart manufacturing includes: China Association for Science and Technology, China Automobile Engineering Society, China Electrotechnical Society, the Chinese Electronic Society, Automation Society of China, the China Society of Agricultural Machinery, etc.

As China is adding innovative power to its manufacturing power, there are more and more local providers of Smart Manufacturing solutions. The key areas of suppliers in the local market are: industrial robots, industrial software, artificial intelligence, internet of things and big data analysis. In the area of industrial robot, large Chinese domestic robot enterprises lie in the third and fourth tiers, represented by Xinsong, GSK CNC Equipment, Efort, Eston, STEP and others. In terms of industrial software, North China and East China are the regions with the most applications, accounting for about half of the whole country. China's industrial software product categories have been relatively complete, covering automotive, engineering machinery, aerospace, electronics, home appliances, etc., with a certain degree of industrial technology R&D capabilities. Looking at industrial intelligence area, computer vision and autonomous driving, robotics and smart chips, have the most potential. In terms of locations, Beijing, Shanghai and Guangzhou are the most attractive regions to find local suppliers, with Jiangsu and Zhejiang Provinces are firmly located in the second tier.

[2] In the regions Beijing Trade Office covers, China Petrochemical Corporation ranked first, followed by China Minmetals and China Chemical Group.

[3] As to the regions Beijing Trade Office covers, Dongfeng Motor Group, China FAW Automotive Group, and Beijing Automotive Group Co.,Ltd are the main three players.

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Chapter 1 – Current situation of smart manufacturing in China

1.1 Definition and background of smart manufacturing

With the development of new science and technology, manufacturing industry in various countries has started a new wave of change. Since the first industrial revolution triggered by the invention of steam engine in the 1760s, the manufacturing industry has gone through three stages, from mechanization to electrical automation and now digitalization, entering into the development stage of industry 4.0 represented by network and intelligence. Currently, the definition of smart manufacturing includes three parts: "digitization", "networking" and "intelligence", finally forming a highly collaborative manufacturing mode capable of self-perception, self-decision and self-execution.

The manufacturing industry in China continues to develop rapidly, and its manufacturing added value ranks the first in the world. In 2010, China's manufacturing industry surpassed the United States to become the country with the highest manufacturing added value in the world. In 2018, China's manufacturing value-added rate was 21.17%.[i] In general, for the past 10 years, the CAGR for manufacturing added value in China was around 12%. It is expected that China will continue to play an important role in the world stage of manufacturing in the future.[ii]

While if looking from the angel of per capita industrial added value, although China owns a strong share in manufacturing sector, it is still far from a manufacturing power. According to the statistics of the World Bank, China only accounts for 1/5 of the per capita industrial added value of the United States, and 1/3 of that of the republic of Korea.

1.2 Policy drives smart manufacturing - Made in China 2025

In order to realize economic transformation and get their national competitiveness, many countries around the world are striving to take initiatives. For instance, American government proposed Re-industrialization and Industrial Internet, Germany announced Industry 4.0, and Chinese government published Made in China 2025 national strategy (hereby: **MIC25**).

MIC25 has the aim of enhancing the country's manufacturing capabilities. Different from the German Industry 4.0, MIC25 has had a weak starting point and was facing the challenge of improving several competitive capabilities simultaneously, i.e., innovation, quality, ecology, etc., while it has clear goals, measures and sector focus.

1.1.1 The Target

“Made in China 2025” policy was firstly announced on March 5, 2015, by China Premier

Li Keqiang, when he was delivering the yearly government work report. It is an action plan for the first decade of the Chinese government's manufacturing strategy. Specifically, it is required to insist the basic policy as " innovation-driven, quality first, green development, structural optimization, and talent oriented", and take basic principles as “market-oriented and guided by the government, focus on the present and the future, promote overall progress, make breakthroughs in key areas, pursue independent development and open cooperation”. With that, "three steps" were planned to be achieved gradually: in 2025, China is expected to join the world’s manufacturing powerhouse ranks; by 2035, China's manufacturing industry as a whole is expected to reach the middle level of the world's manufacturing powers, and; by the year of 2049 – a hundred year since the found the People's Republic of China, China’s comprehensive strength is expected to enter into the forefront of world manufacturing powers.

1.1.2 Main Industries

The MIC25 policy indicates a few main industries for development:

(1) **New generation of information technology industry**, including integrated circuits, cyber security, telecommunication equipment, operating systems and industrial software.

(2) **High-end Computer Numerical Control (CNC) machine tools and robots,** including robots manufacturing, applications for industrial robots, and manufacturing of service robots.

(3) **Aerospace equipment**, including aviation and space equipment, development of wide-body passenger aircraft, and industrialization of jets, helicopters and UAVs.

(4) **Marine engineering equipment and high-tech ships**, including development of equipment for deep-sea exploration, and utilization of resources.

(5) Advanced rail transit equipment

(6) Energy-saving and New energy automobiles

(7) **Electric equipment**, including power generating units, advances energy storage devices, and smart grid solutions.

(8) Agricultural machinery and equipment, including Agri-IoT solutions

(9) New materials

(10) Biomedicine and high-performance medical devices

1.1.3 Incentives

After a series of policy documents, such as MIC25 are released from national level, provincial and local governments set their own policies according to their own circumstances. In general, it is to subsidize the production enterprises, encourage local governments to reward the projects listed in the national intelligent manufacturing pilot demonstration, and give financial support to the projects that are supported by the national intelligent manufacturing comprehensive standardization and the application of new models. In addition, the local governments encourage and support the construction of various intelligent manufacturing service platforms, and strengthen strategic cooperation with industry and information technology departments at all levels.

1.1.4 Measurements

In the "made in China 2025" plan, the government has put forward several development goals:

(1) Indicators reflecting innovation ability

The MIC25 initiative calls for mastering core technologies in a number of key areas by 2020, further enhancing competitiveness in competitive areas, significantly enhancing innovation capacity, and enhancing its position in the global division of labor and value chain by 2025. Two objectives and tasks were determined:

First, the proportion of the internal expenditure of R&D expenditure out of the main business income, for manufacturing companies above designated scale. The average annual growth rate of R&D intensity in China's manufacturing industry should reach 1.26% in 2020 and 1.68% in 2025. In accordance with OECD statistics - the average annual growth rate of R&D intensity in China's manufacturing industry from 1999 to 2012 was 5.9%. In 2019, however, the R& D intensity was 2.14%, 0.06 percentage points higher than that of the previous year, marking the "three consecutive increases" in R & D intensity since 2016.[iii]

Second, the number of effective invention patents per 100 million RMB of main business income of manufacturing industries above designated scale. From 2006 to 2013, the number of effective invention patents per 100 million RMB of China's main manufacturing industries increased from 0.16 to 0.36, with an average annual growth of 12.4%. In the next ten years, according to the average annual growth rate of 12.4 percent, the 2020 and 2025 targets will reach 0.83 and 1.48 respectively. More generally, the number of invention patents increased rapidly from 75,055 in 2013 to 271,158 in 2019, with an annual compound growth rate of 23.87%.[iv]

(2) Indicators reflecting quality and efficiency

Indicators reflecting quality and efficiency of industrial development mainly include the quality competitiveness index of manufacturing industry, the value-added rate of manufacturing industry and the growth rate of total labor productivity.

The quality competitiveness index of manufacturing industry is a comprehensive index of economy and technology reflecting the overall quality of China's manufacturing industry. When MIC25 was initiated, it was expected that the situation of insufficient international market demand will hardly show fundamentally improvement, the competitive advantage of traditional low-end industries will inevitably weaken, and quality competitiveness will continue to maintain a medium-low growth rate. For this reason, in accordance with the average annual growth rate of 0.19 points from 2010 to 2013, it should reach 84.5 points in 2020 and 85.5 points in 2025.

The rate of manufacturing added value. Affected by the global financial and economic crisis in 2008, the value added rate of China's manufacturing industry dropped rapidly from 2008 to 2011, and began to stabilize in 2012-2013. MIC25 emphasized that China's manufacturing industry structure adjustment and industrial upgrading will be accelerated, the proportion of heavy industry and processing trade will be reduced, and the manufacturing industry will gradually reach high value-added mode. It was expected that during the 13th five-year plan period, the value-added rate of manufacturing industry will come out of the trough, and increase by 2 percent in 2020 compared with that in 2015, and return to the level before the financial crisis by 2025, 4 percentage higher than that In 2015. According to the most updated statistics, by the end of 2019, the rate of manufacturing added value in China was 6.2%.[v]

The rate of total labor productivity in manufacturing industry. There is a big gap between China's manufacturing productivity and that of developed countries, but the growth rate of China is much higher than that of the U.S., Japan, Germany and other developed economies. In MIC25, it was aimed that as China's industrial economy enters a new normal, the growth rate of manufacturing added value will gradually slow down, while the scale of manufacturing employment will be relatively stable and the structure will be optimized. It was estimated that during the 13th five-year plan period and the 14th five-year plan period, the average annual growth rate of total labor productivity in manufacturing will be around 7.5% and 6.5% respectively. According to the most updated statistics, in 2018, China's manufacturing productivity was 28,974 USD/ person, only 19.3% of that of the United States, 30.2% of Japan and 27.8% of Germany.[vi]

(3) Indicators reflecting the integration of IT application with industrialization

During the 13th five-year plan period (2016-2020), according to the development goal of "broadband China" strategy and implementation plan promulgated by the state council, China's fixed broadband access users should reach 400 million by 2020, of

which about 330 million are home broadband users, and the penetration rate of fixed broadband households will exceed 70%. During the 14th five-year plan period (2021-2025), the fixed broadband development of China should reach 480 million, among which the broadband users will reach 390 million households, and the fixed broadband penetration rate will be 82%, reaching the current average development level of that in developed countries. According to the most updated data, by the end of June 2019, the population penetration rate of fixed broadband reached 31.1%, which exceeded the average level of 36 OECD countries (30.9%) for the first time. The number of fixed broadband users was 435 million, an increase of about 41 million from the end of 2018.[vii]

(4) Indicators that reflect green development

China realizes that the key of sustainable development is in the Industry, while the difficulty also lies in the Industry. As industrial energy consumption accounts for more than 70% of the total social energy consumption, and industrial emission pollution is the main source of China's pollution. Made in China 2025 calls for energy consumption, material consumption and pollutant emissions per unit of industrial added value in key industries to reach world advanced levels by 2025.

Made in China 2025 also sets four quantitative indicators, namely, energy consumption per unit of industrial added value above designated size will be 18% lower in 2020 and 34% lower in 2025 than that at the end of the 12th five-year plan period. In addition, Carbon dioxide emissions per unit of added value from industry will fall by 22% and 40%, respectively. Moreover, water consumption per unit of industrial added value will be reduced by 23% and 41%, respectively. While the comprehensive utilization rate of industrial solid waste will be increased from 65% in 2015 to 73% and 79% respectively in 2020 and 2025. According to the most recent data, by 2019, the added value of industrial enterprises above designated size unit energy consumption declined to 15.6%, and Carbon dioxide emissions per unit of added value from industry fell by 18% in 2019 than in 2015. In 2019, water consumption per unit of industrial added value decreased 17.93% annually, while the comprehensive utilization rate of industrial solid waste is expected to reach 73% in 2020.[viii]

Chapter 2 – Mapping the Industrial Centers in China

2.1 Geographical Introduction

To evaluate the industrial level of a province or a city, we should look at its: industrial output value, the industrial efficiency, the number of emerging industries and high-tech industries, and the number of scientific & technological inventions. Among them, the industrial output value is one of the key indexes that we ought to study.

2.1.1. Provincial introduction

In terms of the number of industrial enterprises, Guangdong, Jiangsu, Zhejiang and Shandong are the four major provinces in China's economy, with a combined number of 172,050 industrial enterprises, accounting for 45.5% of the country's total. As to the ranks among municipalities directly under the central government, Shanghai ranks first, followed by Chongqing, Tianjin and Beijing. Among all provinces, the last three are Qinghai, Hainan and Tibet.

Table 1: Number of Industrial Enterprises and Revenue from Main Businesses by Province[ix]

Region	Number of enterprises	Rank	Revenue (Billion RMB)	Rank
Guangdong	47,456	1	13,561.61	1
Jiangsu	45,675	2	12,808.56	2
Zhejiang	40,586	3	6,865.38	4
Shandong	38,333	4	9,270.36	3
Henan	22,081	5	4,662.76	6
Anhui	19,421	6	3,935.49	10
Fujian	17,470	7	5,129.8	5
Hunan	16,055	8	4,662.76	7
Hubei	15,598	9	4,325.81	8
Hebei	14,943	10	3,783.55	12
Sichuan	14,205	11	4,064.67	9
Jiangxi	11,630	12	3,207.74	13
Shanghai	8,130	13	3,844.57	11
Chongqing	6,772	14	1,967.44	17
Liaoning	6,621	15	2,648.99	14
Shan'Xi	6,426	16	2,306.04	15
Guangxi	6,958	17	1,870.79	19
Jilin	5,963	18	1,363.75	22

Guizhou	5,583	19	939.08	25
Tianjin	4,292	20	1,754.97	20
Yunan	4,260	21	1,322.74	23
Shanxi	3,875	22	1,925.21	18
Heilongjiang	3,740	23	907.8	26
Beijing	3,197	24	2,143.57	16
Xinjiang	3,025	25	1,032.82	24
Inner Mongolia	2,832	26	1,402.31	21
Gansu	1,917	27	888.89	27
Ningxia	1,250	28	430.56	28
Qinghai	586	29	217.79	30
Hainan	337	30	220.23	29
Tibet	123	31	25.76	31

While referring to the revenue from main businesses, the top four provinces are still Guangdong, Jiangsu, Shandong and Zhejiang, with a total of 42,505.91 billion yuan, accounting for 41.6 percent of China's total. The number of industrial enterprises above scale in Shandong is not as large as that in Zhejiang, but it has passed Zhejiang in terms of main business income, indicating that the industrial enterprises above scale in Shandong are larger, and the situation in Beijing is similar. The bottom three are still Hainan, Qinghai and Tibet, with a combined 463.78 billion yuan, only 3.42% of that in Guangdong.

Specifically, in the region that Beijing Trade Office covers, the top four provinces are still Shandong, Henan, Hubei and Hebei, followed by Liaoning and Shan'Xi. Tianjin and Beijing also has their own advantages in terms of main business income.

As can be seen in Table 2 below, according to the industrial output value, the largest industrial province is Jiangsu, with a production value of 15.49 trillion yuan. It ranks first in China's provincial output value, accounting for 13.3% of the national total. The second largest industrial province is Shandong, with a production value of 14.26 trillion yuan, accounting for 12.25% of the national total. The third largest industrial province is Guangdong, with a production value of 13.55 trillion yuan, 11.64% of the country's industrial output.

In the second ladder, Henan, Zhejiang, Hebei and Fujian also own their power in industrial sectors. As follows, Hubei, Anhui, Sichuan are exceeded a production value of 4 trillion yuan. An interesting figure is, Tianjin and Inner Mongolia's output value drops extremely, Tianjin drops 38.9%, and Inner Mongolia drops 31.1%. Specifically, in the regions that Beijing office covers, Shandong, Henan and Hebei are the most promising three provinces that has good potential in industries.

2.1.2. Municipal introduction

As shown in Table 2 below, the top 10 cities for industrial added value in 2019 were Shenzhen, Shanghai, Suzhou, Tianjin, Chongqing, Chengdu, Guangzhou, Wuhan, Wuxi and Ningbo. Apart from Tianjin, all other cities are from the south. In the second ladder, Ningbo, Foshan and Beijing owns the industrial added value of more than 4.4 trillion yuan, followed by Quanzhou, Hangzhou and Qingdao, also exceeding the value of 4 trillion yuan. [x]

Looking at the distribution of coastal and inland cities, there are 7 coastal areas, including 4 in the Yangtze River Delta, namely Shanghai, Suzhou, Wuxi and Ningbo. The Pearl River Delta has two cities, Shenzhen and Guangzhou. Tianjin is also the focus point in Beijing-Tianjin-Hebei area; in addition, there are three cities in the central and western regions, namely Chongqing, Chengdu and Wuhan. These three cities are also important industrial bases in China, and are key cities of the central and western regions and major cities of higher education.

In the regions that Beijing office covered, Zhengzhou and Changsha are also among the top 20 cities in terms of industrial added value, respectively as 3.7 and 3.6 trillion yuan.

Table 2: Industrial Added Value by Province and Leading Cities[xi]

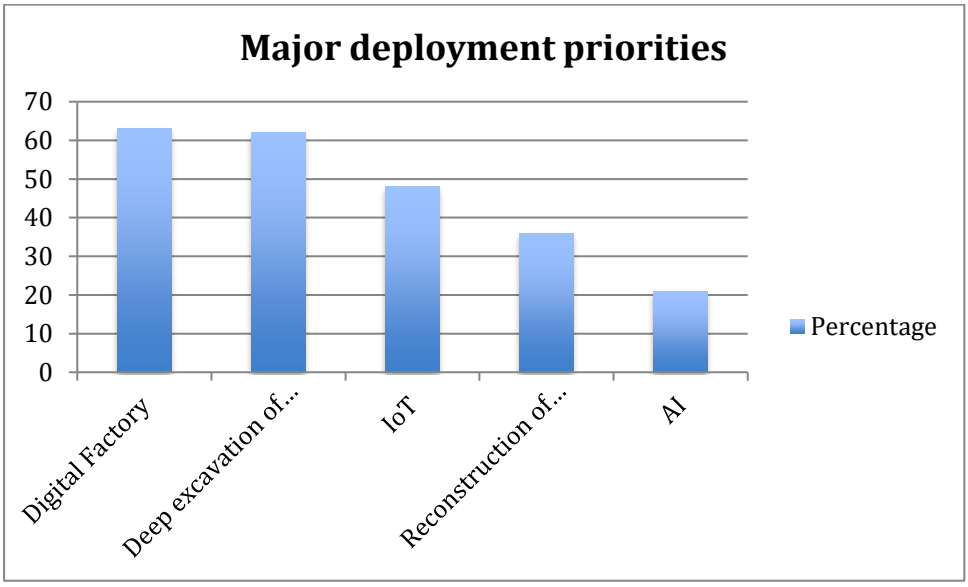
Region	Gross Industrial Output Value (Billion RMB)	Province Rank	City	Industrial Added Value (Billion RMB)	City Rank
Jiangsu	15489.9	1	Suzhou	824.0	3
			Wuxi	500.9	9
			Nanjing	405.5	16
			Nantong	328.0	20
Shandong	14266.0	2	Qingdao	413.7	15
			Jinan	214.1	24
Guangdong	13559.8	3	Shenzhen	925.4	1
			Foshan	459.0	11
			Guangzhou	562.2	7
			Dongguan	390.4	17
Henan	8060.5	4	Zhengzhou	374.6	18
Zhejiang	6708.1	5	Ningbo	495.3	10
			Hangzhou	416.0	14
Hebei	5190.0	6			
Fujian	4800.4	7	Quanzhou	434.6	13
			Fuzhou	241.6	23
Hubei	4353.1	8	Wuhan	507.6	8
Anhui	4340.8	9	Hefei	286.0	21

Sichuan	4242.3	10	Chengdu	566.4	6
Hunan	3946.3	11	Changsha	366.4	19
Shanghai	3742.6	12			
Jiangxi	3558.5	13			
Guangxi	2417.0	14			
Jilin	2316.2	15			
Liaoning	2248.0	16	Dalian	263.3	22
			Shenyang	190.2	25
Shan'Xi	2237.5	17			
Chongqing	2133.3	18	Chongqing	599.8	5
Beijing	2035.4	19	Beijing	446.5	12
Shanxi	1772.5	20			
Tianjin	1701.9	21	Tianjin	696.3	4
Inner Mongolia	1363.8	22			
Yunnan	1205.8	23			
Guizhou	1108.5	24			
Heilongjiang	1015.8	25			
Xinjiang	976.8	26			
Gansu	848.7	27			
Ningxia	408.3	28			
Qinghai	209.4	29			
Hainan	183.1	30			
Tibet	20.7	31			

2.2 Sectorial Division

The smart manufacturing industry chain covers intelligent equipment (robots, CNC machine tools, service robots, other automation equipment), industrial Internet (machine vision, sensors, RFID, industrial Ethernet), industrial software (ERP / MES / DCS, etc.), 3D printing, as well as the integration of automation systems and production lines that combine the above links and machines.

In 2018, Deloitte[xii] surveyed 200 manufacturing enterprises in China. According to the Deloitte survey, five major deployment priorities of Smart Manufacturing for Chinese industrial enterprises will be reached: Digital Factory (63% of industrial enterprises), deep excavation of equipment and user value (62%), industrial Internet of things (48%), reconstruction of ecological and business model (36%) and artificial intelligence (21%). From the perspective of relevant technologies, the technologies who are promising include industrial software, sensor technology, communication technology, artificial intelligence, Internet of things, big data analysis, etc.



Chapter 3 – Major Smart Manufacturing Players in China

3.1 Government

At national level, **the State Council** issued a series of strategic policies, e.g. "Made in China 2025", "Guiding opinions on the Internet+", "Guiding opinions on deepening the integration development of manufacturing and the Internet", etc., which has been providing a powerful system support for Smart Manufacturing development.

Apart from State council, **Ministry of Industry and Information Technology (MIIT)**, and **the National Development and Reform Commission (NDRC)** also play key roles in supporting smart manufacturing. For example, in July 2018, the MIIT published the list of 2018 intelligent manufacturing pilot demonstration projects, with 99 projects shortlisted, following that the number of projects in 2015-2018 was 305, involving 233 enterprises.[xiii] At the same time, the NDRC has also launched pilot demonstration projects of intelligent manufacturing, aiming to encourage the construction of intelligent manufacturing units, intelligent production lines and intelligent factories.

At provincial government, Departments of Science and Technology, and Departments of Industry and Information Technology are the key two sections supporting smart manufacturing. Likewise, **at city level**, Bureaus of Industry and Commerce, and Bureaus of Science and Technology are also the relevant government organizations that cover manufacturing sector. A series of policies has been issued by provincial and city level as well to support local development of Smart Manufacturing.

3.2 Manufacturing companies

According to the 2019 list of China's top 500 manufacturing companies,[xiv] China

Petrochemical Corporation ranked first with revenue of 2.74 trillion yuan, while SAIC and Huawei Investment holdings ranked second and third with revenue of 902.1 billion yuan and 721.2 billion yuan respectively.

Table 3: China's Top Manufacturing Companies 2019[xv]

Rank	Company Name	Sector	Headquarter Location	Revenue (billion yuan)
1	China Petrochemical Corporation LTD	Chemical	Beijing	2742.8
2	Shanghai Automotive Group co., LTD	Automotive	Shanghai	902.2
3	Huawei Investment Holding co., LTD	Telecommunications equipment	Shenzhen	721.2
4	Dongfeng Motor Group co., LTD	Automotive	Wuhan, Hubei	601.5
5	China FAW Automotive Group co. LTD	Automotive	Chuangchun, Jilin	594.0
6	China minmetals co., LTD	Chemical	Beijing	529.7
7	Amer International Group	Chemical		505.1
8	Beijing Automotive Group Co.,Ltd	Automotive	Beijing	480.7
9	China Ordnance Industry Group Co., Ltd	Military	Beijing	454.9
10	China Chemical Group Co., Ltd	Chemical	Beijing	445.8
11	China Aviation Industry Group Co., Ltd	Aviation	Beijing	438.8
12	China Baowu iron and Steel Group Co., Ltd	Manufacturing	Shanghai	438.6
13	Hengli Group Co., Ltd	Textile	Wujiang, Jiangsu	371.7
14	Guangzhou Automobile Industry Group Co., Ltd	Automotive	Guangzhou, Guangdong	364.1
15	China National Building Materials Group Corporation	Construction	Beijing	348.0
16	Lenovo Group Co., Ltd	Telecommunications equipment	Beijing	337.6
17	Hegang Group Co., Ltd	Construction	Shijiazhuang, Hebei	336.8
18	Zhejiang Geely Holding Group Co., Ltd	Automotive	Hangzhou, Zhejiang	328.5
19	China Shipbuilding Industry Group Co., Ltd	Construction	Beijing	305.0
20	Aluminum Corporation of China Limited	Chemical	Beijing	300.2
21	Shandong Weiqiao Pioneering Group Company	Textile	Binzhou, Shandong	284.5

22	Haier group corporation	Consumer electronics	Qingdao, Shandong	266.1
23	Midea Group Co., Ltd	Consumer electronics	Shunde, Guangdong	261.8
24	China Aerospace Science and Engineering Group Co., Ltd	Aviation	Beijing	250.5
25	China Aerospace Technology Group Co., Ltd	Aviation	Beijing	249.6

From this top 500 list, on the whole, we can see some more interesting information and comparison to previous years. For example, the manufacturing industry Top 500 scale is rising steadily. In terms of the revenue, the total operating revenue was 34.92 trillion yuan, an increase of 9.67% over the previous year. Assets totaled 36.47 trillion yuan, an increase of 6.89% over the previous year. From the perspective of operating performance, the growth rate of net profit remained high, with a total profit attributable to the parent company of 976.729 billion yuan, increased 19.44% from the previous year. The profit margin on net assets increased three times in a row, reaching 10.48%, 1.25% higher than that of the previous year. Last, the asset-liability ratio continued to improve, at 62.74%, decreased 0.46% from the previous year.[xvi]

From the perspective of innovation, the R&D investment of the Top 500 enterprises continued to rise, and the total R&D expenditure reached 711.087 billion yuan, an increase of 8.63% over 2018. The R&D intensity was 2.14%, 0.06% higher than that of the previous year. Leading enterprises become the main body of innovation. Among the top 10 enterprises, invention patent number reached 136,622 cases, accounting for 50.38% of the total 500 invention patents during 2019.[xvii]

Referring to sectors, heavy chemical industry still occupies a dominant position. Among all industry types in the list, the 5 industries with the largest operating revenue scale are all heavy chemical industry, and their total operating revenue accounts for 51.55% of the Top 500. As follows, the telecommunications equipment sector moving into the top five for total profits. Huawei ranked 1st in this catalogue obviously, followed by Lenovo Group as 3.37 trillion yuan as revenue. In addition, automotive companies also should be paid attention: among the top 25 list, 6 are from automotive sector. Moreover, two consumer electronics companies also ranked within top 25 list, specifically, Haier Group Corporation reached 2.66 trillion yuan as revenue, followed closely by Midea Group as 2.61 trillion yuan.

Last but not least, the overseas revenue of the top 500 manufacturers expanded steadily, growing faster than the total revenue for two consecutive years. 2019 overseas revenue of China's top 500 manufacturers was 4.22 trillion yuan, rising 11.94% from the previous year, 2.27% higher than the growth rate of total revenue.

3.3 Major associations and trade organizations

At national level, major associations and organizations related with smart manufacturing includes: China Association for Science and Technology, China Automobile Engineering Society, China Electrotechnical Society, the Chinese Electronic Society, Automation Society of China, the China Society of Agricultural Machinery, etc. At Provincial and City levels, there are also related organizations.

3.4 Local suppliers of advanced manufacturing solutions

In the 2019 Top Manufacturing Companies list, there are also Smart Manufacturing solutions companies, and there are many more outside of this list. For most Chinese industrial enterprises, industrial software, sensor technology, communication technology, artificial intelligence, Internet of things, big data analysis are the popular technology directions to develop.

3.4.1 Smart manufacturing equipment

Smart manufacturing equipment involves: industrial robots, 3D printing equipment, CNC machine tools, intelligent control systems, sensors and other major industries. The industrial scale has achieved rapid growth. According to the statistics of the Ministry of Industry and Information Technology, since 2010, the scale of China's manufacturing output value accounted for 19% - 21% of the world. In 2019, the value was 27%.[xviii]

(1) Industrial robot

China has achieved phased results in the field of industrial robot, and in 2018, the growth rate of China's intelligent robot market scale was 26%, reaching 2.876 billion yuan. In 2019, more than 30 cities in China have taken the intelligent robot industry as the key direction of local development, among which Shenzhen was expected to increase the value of the intelligent robot industry to 200 billion yuan, while Guangzhou, Chongqing, Nanjing, Hubei set the industrial scale target at more than 100 billion yuan.[xix]

In terms of industrial robots application worldwide, the largest application lies in the field of automobile manufacturing, accounting for 38.7%. In fact, the percentage is much larger in China, accounting for nearly 50%.The robot market in China can be divided into four tiers:

First, ABB, Fanuc, Yaskawa and KUKA, with a market share of more than 50%. In this tier, those brands represent the world's advanced level, and their system integration occupy a high-end and dominant position, especially in the automotive industry and the formation of a strategic partnership with OEMs. In the second tier, international brands such as Comac, OTC, NACHI, Mitsubishi, EPSON, kawasaki, ADEPT are listed, as well as important system integrators such as CLOOS.

Large Chinese domestic robot enterprises lie in the third tier. Represented by Xinsong, GSK CNC Equipment, Efort, Eston and STEP. The gap between the products of these enterprises and the first tier is large, but some of them are close to the second tier. Other domestic small and medium-sized robot enterprises or new enterprises are representing the fourth tier, characterized by a large number and fast growth, while generally with a lack of technology accumulation, mainly rare low-end products.

Table 4: Top 20 list of industrial robots companies in China 2019[xx]

	Company	Headquarter	Province
1	Shenyang Xinsong Robot Automation Co., Ltd	Shenyang	Liaoning
2	Jingdong Digital Technology Holding Co., Ltd	Beijing	Beijing
3	Shanghai ABB Engineering Co., Ltd	Shanghai	Shanghai
4	Stauber (Hangzhou) Precision Machinery Electronics Co., Ltd	Hangzhou	Zhejiang
5	Haining Ha Gong modern robot Co., Ltd	Haining	Jiangsu
6	Sinomach Intelligence Technology Co., Ltd	Guangzhou	Guangdong
7	Shanghai New Era Robot Co., Ltd	Shanghai	Shanghai
8	Beijing jizhijia Technology Co., Ltd	Beijing	Beijing
9	Foxconn industrial Internet Co., Ltd	Shenzhen	Guangdong
10	Nanjing Easton Automation Co., Ltd	Nanjing	Jiangsu
11	Nanjing Panda Electronics Co., Ltd	Nanjing	Jiangsu
12	Guangdong Topstar Technology Co., Ltd	Donguan	Guangdong
13	Yijiahe Technology Co., Ltd	Nanjing	Jiangsu
14	Jiangsu Ha Gong intelligent robot Co., Ltd	Jiangyin	Jiangsu
15	CloudMinds Co.,Ltd	Shenzhen	Guangdong
16	Sanfeng Intelligent Equipment Group Co., Ltd	Huangshi	Hubei
17	Guangdong Bright Dream Robot Co., Ltd	Foshan	Guangdong
18	Jiangsu Jerui Technology Group Co., Ltd	Lianyungang	Jiangsu
19	Hefei Xinyihua Intelligent Machine Co., Ltd	Hefei	Anhui
20	Yaskawa Shougang Robot Co., Ltd	Beijing	Beijing

(2) High grade CNC machine

In the global machine tool electronic market, the market scale of CNC system is 20 billion US dollars, accounting for 63.9% of the total market scale of machine tool electronic market.[xxi] China's manufacturing industry has always been inseparable from opening up and attracting foreign investment. "Made in China 2025" strategic goal should also be carried out under the deepening of reform and opening up, continue to attract new CNC technology and experience from all countries.

Table 5: Top 10 list of CNC companies in China 2019[xxii]

	Company	Headquarter	Province
1	Mazak (China) LTD	Shanghai	Shanghai
2	DMG MORI	Shanghai	Shanghai
3	Trumpf (China) LTD	Taicang	Jiangsu
4	Amada (China) LTD	Shanghai	Shanghai
5	Okuma (China) LTD	Shanghai	Shanghai
6	SMTCL LTD	Shenyang	Liaoning
7	DMTG LTD	Dalian	Liaoning
8	EMAG (China) LTD	Changzhou	Jiangsu
9	MAKINO (China) LTD	Kunshan	Jiangsu
10	JIER Machine Tool Group	Jinan	Shandong

(3) 3D printing

Due to the late introduction of 3D printing technology in China, there is a certain gap with foreign countries, but in recent years, it has also developed rapidly. At present, China's 3D printing applications mainly focus on home appliances and consumer electronics, mold testing, medical and dental orthodontics, automobiles and other means of transportation, aerospace and other fields. According to the report on market prospect and investment of 3D printing industry in 2019,[xxiii] the scale of China's 3D printing market in 2018 reached 2.36 billion yuan, up nearly 42% year on year. With the corresponding maturity of China's 3D printing technology, the demand in aerospace, automobile and other industries will continue to increase.

Table 6: Main list of 3D Printing companies in China 2019[xxiv]

	Company	Headquarter	Province
1	Sunshine Laser Tech LTD	Shenzhen	Guangdong
2	Yinbang Clad Material Co., Ltd	Wuxi	Jiangsu
3	AVIC Heavy Machinary Co.,LTD	Guizhou	Guizhou
4	Golden Laser Co.,LTD	Wuhan	Hubei
5	HG Tech Co.,LTD	Wuhan	Hubei
6	BRC Co.,LTD	Chengdu	Sichuan
7	Hunan Honyu Wear-Resistant New Materials Co., Ltd.	Changsha	Hunan
8	NanFeng Corporation	Foshan	Guangdong

9	Han's Laser	Shenzhen	Guangdong
10	AMSKY Technology Co., Ltd.	Guangzhou	Guangdong

3.4.2 Intelligent devices

In recent years, artificial intelligence industry has developed rapidly in China. According to the statistics, from 2015 to 2019, the Chinese artificial intelligence industry compound average growth rate of 54.6%, higher than the global average level (around 36%). The market size of China's AI industry reached 41.55 billion yuan in 2019. AI enterprises are widely distributed in 18 application fields, with the number of enterprises in the key technology R&D, and application platforms accounting for the highest percentage, reaching 15.7% and 10.5% respectively. Within this segment, we can include the following industries: automotive including autonomous driving, smart home applications and UAVs, all are leading industries in China.

Intelligent device mainly means smart terminals. With the development of AI and the upgrading of broadband technology, smart phone enterprises begin to focus on the layout of smart terminals, while the smart ecological key point is different: Xiaomi is committed to building smart home ecology; IflyTech is committed to business ecology; and Huawei launched Hongmeng system, aims to promoting the whole-scene strategy. In addition, with the maturity and popularity of 5G technology, the smart device market is expected to continue to grow rapidly. Among the specific fields, computer vision and autonomous driving, robotics and smart chips, have the most potential. In terms of locations, Beijing, Shanghai and Guangzhou are the most attractive regions, with Jiangsu and Zhejiang firmly in the second tier. In addition, investment and financing for AI industry is mainly concentrated in Beijing, Guangdong and the Yangtze river delta, with Beijing far ahead of other cities.

Table 7: Top 20 list of Industrial Intelligence Companies[xxv]

	Company	Headquarter	Province
1	Alibaba Group	Hangzhou	Zhejiang
2	Baidu Technology	Beijing	Beijing
3	Tencent Group	Shenzhen	Guangdong
4	Huawei Technology Co., Ltd	Guangzhou	Guangdong
5	Ifly-Technology Co.,Ltd	Beijing	Beijing
6	BGI Group	Shenzhen	Guangdong
7	Hikvision Technology	Hangzhou	Zhejiang
8	Ant Financial Services Group	Hangzhou	Zhejiang
9	ByteDance	Beijing	Beijing

10	Jingdong Digital Technology Holding Co., Ltd	Beijing	Beijing
11	Shenzhen DJI Technology	Shenzhen	Guangdong
12	Xiaomi	Beijing	Beijing
13	Sugon Technology	Beijing	Beijing
14	NetEase	Guangzhou	Guangdong
15	Beijing Sogou Information Technology	Beijing	Beijing
16	Inspur Group Co., Ltd	Jinan	Shandong
17	SenseTime Technology	Beijing	Beijing
18	Cambricon Technology	Beijing	Beijing
19	MegVii Technology	Beijing	Beijing
20	NavInfo Technology	Beijing	Beijing

3.4.3 Intelligent service product

The areas of R&D, design, logistics, distribution, marketing, e-commerce, finance, etc, and has become one of the dominant factors in improving the competitive ability of the enterprise and reaching economic benefit. Intelligent service, as an important competitive means to increase the added value of products, presents a trend of servitization in manufacturing industry. This area is too wide to map the leading companies in it.

3.4.4 Other related industry chain product

Smart logistics

According to iiMedia Research,[xxvi] the current demand of logistics enterprises for smart logistics mainly includes logistics data, logistics cloud and logistics equipment. The most recent data show that in 2018, the market size of smart logistics exceeded 400 billion yuan, and it is estimated that by 2025, the market size of smart logistics will exceed one trillion yuan.

Table 8: Top 10 list of Smart Logistics Companies[xxvii]

	Company	Headquarter	Province
1	SF Express (Group) Co., Ltd	Shenzhen	Guangdong
2	Yuantong Express Co., Ltd	Shanghai	Shanghai
3	Shentong express Co., Ltd	Shanghai	Shanghai
4	Shanghai Yunda Freight Co., Ltd	Shanghai	Shanghai

5	China Post Express Logistics Co., Ltd	Beijing	Beijing
6	Debang Logistics Co., Ltd	Shanghai	Shanghai
7	Zhongtong Express Co., Ltd	Shanghai	Shanghai
8	Qingdao ririshun Logistics Co., Ltd	Qingdao	Shandong
9	Sinotrans DHL international air Express Co., Ltd	Shenzhen	Guangdong
10	Youbisu parcel delivery (Guangdong) Co., Ltd	Beijing	Beijing

(2) Intelligent detection

Intelligent detection is a kind of detection technology that minimizes the need for manual labor. According to the most recent data, in 2018, the business income reached 281.05 billion yuan for the detecting industry in China, issuing 428 million test reports. According to Qianzhan Research Institute,[xxviii] the market share of detecting industry will be expanded to more than 600 billion yuan. In addition, private markets are becoming the backbone of the intelligent detection industry, due to policy support in China.

Sensors

According to the most updated statistics,[xxix] the market size of China's sensor industry reached 147.2 billion yuan by 2018, up 13.2% year on year. From the sensor product type structure, the flow sensor accounted for 21%, and the pressure sensor for 19%, with the temperature sensor accounted for 14% and the others as 46%. Specifically, the market size of MEMS (Microelectro Mechanical Systems) sensors in China reached 42 billion yuan in 2019. Moreover, it was estimated that the market size will reach 44 billion yuan and 47 billion yuan respectively in 2020 and 2021.

Table 9: Top 10 list of Industrial Sensor Companies[xxx]

	Company	Headquarter	Province
1	Shanghai luodingsen industrial automation equipment Co., Ltd	Shanghai	Shanghai
2	Xi'an Ansen Intelligent Instrument Co., Ltd	Xi'an	Shan'xi
3	Zhejiang central control automation instrument Co., Ltd	Hangzhou	Zhejiang
4	The 49th Research Institute of China Electronic Technology Corporation	Harbin	Heilongjiang
5	Fujian shangrun Precision Instrument Co., Ltd	Fuzhou	Fujian
6	Micro sensor Co., Ltd	Baoji	Shan'xi
7	Chongqing Chuanyi Automation Co., Ltd	Chongqing	Chongqing

8	Shanghai Lige Instrument Co., Ltd	Shanghai	Shanghai
9	Nanjing wotian Technology Co., Ltd	Nanjing	Jiangsu
10	Guangdong Kangyu measurement and Control Instrument Engineering Co., Ltd	Jiangmen	Guangdong

Industrial Software

In order to fully implement the MIC25 initiative, the MIIT officially released the development plan for the software and information technology service industry (2016-2020). Industrial software has been given priority to be further developed, in the field of industrial design, production, management, etc. In the smart manufacturing process, industrial software is mainly responsible for optimizing, simulating, presenting and making decisions in production control, operation management, R&D and design.

According to CCIDnet statistics,[xxxi] in recent five years, the size of China's industrial software market has been growing at an annual rate of about 10%-20%. Among them, the importance of R&D and design software has been increased, and the application of simulation software in each stage of product life cycle has increased as well. In addition, the application of CAE (Computer-Aided Engineering) software in various fields of manufacturing industry has been increasingly extensive.

In terms of market in various regions, North China and East China are the regions with the most industrial software applications, accounting for about half of the whole country. In terms of provinces and cities, Beijing, Shanghai, Guangdong and Jiangsu are regions with strong industrial software strength, accounting for more than half of China's industrial software market.

From the perspective of industrial chain, the upstream is mainly comprised of the software and hardware that provide basic services for the manufacturing of industrial software products. Among them, hardware companies are mainly about producing computer equipment, e.g., Lenovo, HP, Dell, Apple, Acer, Digital China, etc. In terms of software, it can be divided into operating system, development tools and middleware. Among the development tools, enterprises as Microsoft, Oracle, Genuitec have relatively leading advantages. In the middleware field, IBM, BEA, Kingdee, Dongfang Technology in China have rich experience. While looking at the downstream market, industrial software can be widely used in many fields of industrial manufacturing. After years of efforts, China's industrial software product categories have been relatively complete, covering automotive, engineering machinery, aerospace, electronics, home appliances, national defense military, equipment industry and other fields, with a certain degree of industrial technology research and development capabilities and service support capabilities.

Table 10: Top 20 list of Chinese Industrial Software Companies 2019[xxxii]

	Company	Headquarter	Province
1	Huawei Technology Co., Ltd	Guangzhou	Guangdong
2	Nari Technology Co., Ltd	Nanjing	Jiangsu
3	Shanghai Baoxin Software Co., Ltd	Shanghai	Shanghai
4	Yonyou Network Technology Co., Ltd	Beijing	Beijing
5	ZTE Co., Ltd	Shenzhen	Guangdong
6	Hangzhou Helishi Automation Co., Ltd	Hangzhou	Zhejiang
7	Haier group	Qingdao	Shandong
8	Zhuzhou CRRC Times Electric Co., Ltd	Zhuzhou	Hunan
9	PCITC Co., Ltd	Beijing	Beijing
10	Neusoft Group Co., Ltd	Shenyang	Liaoning
11	Zhejiang Dahua Technology Co., Ltd	Hangzhou	Zhejiang
12	Glondon Technology Co., Ltd	Beijing	Beijing
13	Inspur Group Co., Ltd	Jinan	Shandong
14	Supcon Technology Group Co., Ltd	Hangzhou	Zhejiang
15	Fuzhou FD Automation-Tech Co., Ltd	Fuzhou	Fujian
16	Taiji Computer Co., Ltd	Beijing	Beijing
17	Kingdee software (China) Co., Ltd	Shenzhen	Guangdong
18	Beiming Software Co., Ltd	Guangzhou	Guangdong
19	Beijing Shenzhou Aerospace Software Technology Co.,Ltd	Beijing	Beijing
20	Yuanguang Software Co., Ltd	Zhuhai	Guangdong

Industrial Internet and Big Data

Industrial Internet is the key infrastructure to realize smart manufacturing. In 2019, the market size of China's industrial Internet reached 531.3 billion yuan. When evaluating the capabilities of industrial Internet companies, usually three evaluation indexes will be taken into consideration: technology R&D and innovation capability, application realization capability and development potential. Referring to CCID's release of top 20 industrial Internet companies in 2019, it could be found that, there are diversified types of companies, incl. profound industrial knowledge based manufacturing corps, Internet giants, operators and traditional IT enterprises. Also, outstanding industrial Internet companies in the energy, chemical, electrical and shipping industries are promising. At the same time, many companies on the list also participated in the national and industrial level intelligent manufacturing, industrial Internet pilot and demonstration projects.

Table 11: Top 20 list of Industrial Internet Companies [xxxiii]

	Company	Headquarter	Province
1	Haier group	Qingdao	Shandong

2	BONC Technology Co.,Ltd	Beijing	Beijing
3	Yonyou Network Technology Co., Ltd	Beijing	Beijing
4	RootCloud Technology Co.,Ltd	Beijing	Beijing
5	CASICloud-Technology Co.,Ltd	Beijing	Beijing
6	EVOC Intelligent Technology	Shenzhen	Guangdong
7	Huawei Technology Co., Ltd	Guangzhou	Guangdong
8	Foxconn Industrial Internet	Shenzhen	Guangdong
9	Inspur Group Co., Ltd	Jinan	Shandong
10	Alibaba Cloud	Hangzhou	Zhejiang
11	Xuzhou Construction Machinery Group Co., Ltd. (XCMG)	Xuzhou	Jiangsu
12	Unigroup Cloud Engine Co., Ltd	Suzhou	Jiangsu
13	Beijing SYSWARE Technology Co., LTD	Beijing	Beijing
14	HollySys Group	Beijing	Beijing
15	Histron Technology Co., LTD	Fuzhou	Fujian
16	CEC Industrial Internet Co., LTD	Changsha	Hunan
17	ISESOL Co., LTD	Shanghai	Shanghai
18	Midea Group	Foshan	Guangdong
19	Tencent cloud	Shenzhen	Guangdong
20	Zoomline Group	Changsha	Hunan

Big Data Center

Compared with the United States, although the number of data centers in China is large, the scale is generally small. According to the most recent statistics,[xxxiv] in the global large-scale data center, the United States accounted for 44%, China accounted for 8%, Japan and the United Kingdom accounted for 6%. While the data center industry in China develops rapidly, the capital market keeps paying close attention to this industry, and the integration and merger of the industry is very active. With the strengthening of policy & financial support, the growth rate of China's IDC industry is significantly faster than the global scale, and the proportion of China's scale in the global scale increases significantly. In 2013, the market size of IDC in China reached 21.08 billion yuan, accounting for 15.21% of the global total. By 2017, the proportion of this industry in the global scale rose to 25.57%. Moreover, in 2019 its scale accounted for more than 30%.

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