Analysis of Chinese Intelligent Manufacturing Strategy and Development Situation

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Abstract—Digitization, networking and Intellectualization of manufacturing industries are the core technologies of a new round industrial revolution.In China, intelligent manufacturing strategy is seen as break-through and main direction of "Made in China 2025" action guideline, whose object is to achieve a huge improvement in manufacturing efficiency by promoting the integration of the information technology and manufacturing technology , and transform China from a big nation in manufacturing to a powerful one.The overall research purpose is to make an analysis and gain a deep understanding of the development situation of intelligent manufacturing in China.

The research results show that at the national policy level, there are still many barriers on the development of intelligent manufacturing industry, such as intellectual property protection laws, financial support programs and the formulation of industrial standards. In addition, how to stimulate the innovation ability of state-owned enterprises and provide more effective supports for small and medium-sized private enterprises also needs to be solved. The finding suggested that it is important to form a complete system of industry support and regulatory based on intelligent manufacturing characteristics, then specifies the ways and influencing space of government and enterprises. Only in this way is it possible to realize the transformation of China into a manufacturing powerhouse and achieve efficient development of both state-owned and private manufacturing enterprises.

Keywords—Intelligent Manufacturing, Made in China 2025, Development Situation

INTRODUCTION

Manufacturing is the pillar of the national economy(Kaldor.N,1967).The difference in manufacturing capacity between countries can explain 70% of the difference in income between countries (Hausmann et al.,2011) Since the financial crisis in 2008, developed countries have pursued a strategy of re-industrialization, seeking a leading edge in manufacturing industry(Zhou,C.S,Liu,Y.,2013). Germany announced the Industry 4.0 strategy in 2013(Blanchet al., 2014). The US government launched the Advanced Manufacturing Partnership (AMP) in 2011 and the National Network for Manufacturing Innovation (NNMI) in 2014.Manufacturing in China is big but not strong.

Realizing the transformation from a big nation in manufacturing into a powerful one, has become the most urgent issue in China today (Zhou, J., 2015).

In the past decades, China has achieved rapid economic development with its low labor reward advantages in labor-intensive industries.(Wang,F.，Andrew Mason,2005) With the development of the economy, the demand for labor is growing.However, under the influence of factors such as family planning policies, labor demand is gradually becoming difficult to meet(Wang,X.B.，Herzfeld，T & Glauben，T, 2007).As the working-age population begins to decrease, labor costs in China has risen a lot ,which means labor advantage has disappeared(Cai,F., 2007).

As these challenges, Chinese government issued the "Made in China 2025" action guideline in 2015,The main direction of that is intelligent manufacturing strategy, which takes advantage of advanced information and manufacturing technologies to achieve flexible, smart, and reconfigurable manufacturing processes in order to address a dynamic market, reduce production cost and improve production efficiency(Zhou,J., 2018). State-owned enterprises are the main force in the implementation of intelligent manufacturing strategies, which dominate infrastructure sectors including transportation, energy, electricity, construction and steel. Private enterprises are numerous and become the most active component of the national economy. This paper focuses on the analysis of the policies and measures taken by the government and development of state-owned and private manufacturing enterprises.

INTELLIGENT MANUFACTURING IN CHINA

Since the reform and opening up, China's manufacturing industry has developed rapidly, and has built a complete, independent industrial system, which has effectively promoted the process of industrialization and modernization. However, compared with the world's advanced level, the gap is huge.In this context, from 2011 to 2014, the National Development and Reform Commission, the Ministry of Finance, Ministry of Industry and Information Technology jointly issued the "Intelligent Manufacturing Equipment Development Special Project", focusing on breakthroughs in automatic control systems, industrial robots, and provided financial and taxation policy

support for intelligent manufacturing. Since 2013, President Xi pointed out: The country must rely on the real economy to strengthen its core competitiveness.Subsequently, "Made in China 2025" became the national development action guideline, and intelligent manufacturing strategy is the main development direction, accelerating the integration of the information technology and manufacturing, and striving to reshape the competitive advantage of manufacturing industry in China (Yang, Z.B., 2017). In the past three years, the Ministry of Industry and Information Technology has selected more than 206 intelligent manufacturing pilot demonstration projects (46 in 2015, 63 in 2016, and 97 in 2017), which were well developed and will continue to be strongly supported.

Since the release of "Made in China 2025", most industrial cities in China have established demonstration areas for intelligent manufacturing. Local governments have also issued policies to support the development of intelligent manufacturing, including providing project start-up funds and subsidies, technical expert introduction plan, and tax reduction.

However, intelligent manufacturing development in China is fairly unbalanced, developed southeast coastal areas are much ahead, while others are far behind. The top ten cities or provinces of intelligent manufacturing comprehensive capabilities in China are as follow: Tianjin, Jiangsu Province, Beijing, Shanghai, Guangdong Province, Zhejiang Province, Shandong Province, Chongqing, Sichuan Province, and Fujian Province(Dong,Z.X.，Liu,Y.J., 2016).

During the last two years, "Intelligent Manufacturing Engineering Implementation Guide", "Intelligent Manufacturing Development Plan" and "High-end Intelligent Remanufacturing Action Guideline" were successively issued. In January 2018, "National Intelligent Manufacturing Standard System Construction Guide 2018" was proposed, which includes more than 150 intelligent manufacturing technical standards, covering basic common standards and key technical standards. However, these are far from enough, still a lot of work to be done to form a complete standard system.

In terms of capital, intelligent manufacturing strategy has also strongly supported. The advanced manufacturing industry investment fund, the national integrated circuit industry investment fund, and the national emerging industry venture capital guiding fund have been set up by the government. The scale of these funds exceeds 10 billion, and the largest one exceeds 100 billion. Besides, the subsidy for the robot industry exceeds 40 billion.

From the macro point of view, Chinese government regards intelligent manufacturing strategy as an important opportunity for the overall improvement of manufacturing technology ，and considerable resources have been devoted to supported it, undoubtedly speeding up the development of industrial technology and basic science. However, the gap with developed countries is huge, chinese industrialization started late,and lack of technical accumulation, which

is hard to make up for with money. In the following part, an interview is introducted that was performed to identify the barriers to the Implementation of intelligent manufacturing and main problems that manufacturing enterprises face.

RESULTS AND DISCUSS

The interview was conducted with 8 managers and researchers who had several years working experience in manufacturing and technology enterprises, including stated-owned and private enterprises, in order to get insight into the industry and explore what difficulties and barriers exist.

Table 1: Main Features of each interviewed enterprises

	Enterprise	Field of the enterprise	Interviewee
No.1	A	Iron and steel (Stated-owned)	Manager
No.2	B	Robot (Stated-owned)	Researcher
No.3	C	Home appliance (Stated-owned)	Manager
No.4	D	Electronics (Stated-owned)	Researcher
No.5	E	Robot manufacturing (Private)	Manager
No.6	F	Industrial software (Private)	Researcher
No.7	G	Electronics (Private)	Manager
No.8	H	Automobile (Private)	Manager

During the interview, all of the interviewees affirmed the necessity of the intelligent manufarturing strategy.But in their opinion some barriers will slow the process even the government put much money and policies:

Table 2: Barriers of Intelligent Manufacturing development

	Barriers
No.1	Low efficiency of research and development
No.2	High cost to update the now-using machine and producing line
No.3	Imperfect industry standard framework
No.4	Data security and safety threat
No.5	Inadequate protection of industrial intellectual property rights

For a long time as the "world factory", chinese manufacturing enterprises accustomed to the processing and assembly tasks, research and innovation capacity is weak, difficult to break through key technologies, which leads to heavily dependence on foreign advanced technology (from No.2 and No.4 interviewees).Especially in state-owned enterprises, lack of innovation power is a main problem, because R&D process is usually very long and uncertain, which requires continuous substantial investment and incentives for R & D personnel.

The reason why most small and medium-sized private companies stay in a lower level of digitization and Intelligentization is the high cost of technology and equipment upgrades (from No.5 interviewee). Compared with state-owned enterprises with large-scale assets, private enterprises are not easy to get bank loans, and financing channels are few(from No.6 interviewee).Technology and equipment upgrade requires a large amount of investment in the early stage, but the return on investment is not clear, which makes many enterprises under pressure and dare not to try.

Due to the lack of uniform industry standard, data collection and transmission for the industrial Internet between different type equipments is complicated and ineffective，which to a certain extent affects the development of intelligent manufacturing, from this point of view, complete uniform industry standard system can be seen as a significant premise. (From No.8 interviewee). In addition, industry internet components eventually connect to the Internet. Therefore, industrial systems are also indirectly exposed to the internet, as data and sensitive Information leakage incidents occur frequently, data security of enterprises is threatened, which means for network space security more attention should be paid, that is the same for both state-owned and private enterprises.

The policy boom has attracted a large number of companies; however, the strength of the companies is not balance. Because of the deficiency of industrial intellectual property protection in China, outcomes of R&D are likely to be imitated by other companies at low cost (from No.6 interviewee).

From the perspective of interviewees, it can be seen that although intelligent manufacturing strategy has been strongly supported in China, there are still some barriers and problems, which hinder the development of state-owned and private enterprises.

CONCLUSION AND RECOMMENDATION

Interview result shows that, implementing intelligent manufacturing strategy and improving manufacturing capability is not just a major research task, but a complex and extensive system engineering involving national policies, laws and regulations, industry standards, financial support, and the efforts of researchers, all of which are indispensable. Therefore,

despite the huge investment, this process still has a long way to go.

In order to promote the development of intelligent manufacturing, efforts should be made mainly from the following aspects:

In terms of financial support, it is necessary to broaden the financing channels for intelligent manufacturing, reduce financing costs, and guide social capital to participate in manufacturing project construction.

For the intellectual property protection, government should accelerate the improvement of intellectual property protection policies and the comprehensiveness of industrial common standards that is conducive to the development of intelligent manufacturing.

In education, promote innovation in personnel training system of higher education and increase international exchange projects, focus on cultivating high quality talents with multi-disciplinary background and training professional technical personnel.

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