A Review of Advanced Manufacturing Strategies and Development in Typical Industrialized Countries

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Abstract. The report of the 19th National Congress of the Communist Party of China pointed out accelerating the construction of a manufacturing power, accelerating the development of advanced manufacturing, and promoting the deep integration of the Internet, big data, artificial intelligence and the real economy. This article focuses on the advanced manufacturing strategy of typical industrialized countries, and lays special stress on the analysis of industry 4.0 in Germany, the re-industrialization in the US, and the development and application of artificial intelligence in Japan. This article also puts forward relevant suggestion for promoting the transformation and upgrading of China's manufacturing.

1. Introduction
After the outbreak of the international financial crisis in 2008, promoting “return of manufacturing” and “re-industrialization” has become one of the means for developed countries and emerging economies to cope with the financial crisis and enhance their international competitiveness. Developed countries are concentrated in high-end manufacturing, and emerging economies rely on low-cost advantages to accelerate the construction of new "world factories." The global manufacturing industry presents new features of simultaneous development, differentiation and combination, and reconstruction advantages at both ends.

At the same time, the game of high-end manufacturing in international trade is strengthening. From a global perspective, Germany, the US and Japan are at the forefront of global smart manufacturing. The rest of the countries is also promoting their national competitiveness in order to strengthen or enhance the international competitiveness of the manufacturing industry by strengthening the application of next-generation information technology and building or forming their own domestic advantages. China's manufacturing industry is at an important historical threshold for development, with both great challenges and great opportunities.

2. Industry 4.0 in Germany

2.1. Background
At the beginning of the reunification of Germany, the vast majority of the population was engaged in agriculture. The manufacturing industry mainly existed in hand workshops, and there were very few large factories. Compared to the UK, which is already the world's largest industrial power, the early German factories produced a large number of shoddy and low-end products.

In the context of the emergence of new global manufacturing concepts, the combination of traditional manufacturing technology with industrial software and industrial electronics technology has given Germany an opportunity to consolidate and enhance its technological advantages. Facing the
continuous evolution of new ideas and the continuous development of new technologies, Germany firmly grasps the opportunity of second industrial revolution, focusing on the deep integration of the Internet and industry, and upgrading “Industry 4.0” to a national strategy, vigorously developing the power industry and A series of emerging industries, such as the electrical manufacturing industry, have gradually got rid of the low-end image with low quality and low price of the manufacturing industry at the beginning of the reunification of Germany. It has realized the transformation and upgrading of the industry from the low-end to the high-end, and finally established the status of an industrial power.

2.2. Connotation and characteristics of "Industry 4.0"

Germany's "Industry 4.0" takes the in-depth application of information physics systems in smart factories as the technical point, aiming to become a supplier and leading market for this new generation of industrial production technology, so that German manufacturing industry will continue to maintain global competitiveness. Its main features include:

First, promote equipment interconnection and interoperability by means of "materialization". One of the core of Industrial 4.0 is to connect all kinds of devices to the Internet by using new intelligent sensors, so that the devices have intelligent functions such as computing, communication, control, remote coordination and autonomy. So we can create the Internet of Things and related services, realize real-time communication, mutual recognition and effective communication of people, equipment and products through CPS network, and build a highly flexible personalized and digital intelligent manufacturing mode.

Second, promote the application of modern information technology by "informationization". Another core of "Industry 4.0" is to achieve horizontal, vertical and end-to-end integration. Horizontal integration enables enterprises to achieve seamless cooperation and resource integration through value chain and information network. Longitudinal integration solves the problem of information islands within enterprises and realizes seamless docking of all links within enterprises. End-to-end integration through a series of technologies such as broadband network, communication system, advanced algorithm, control system, management software to constitute the service internet, realize the high-speed transmission of information and a large number of storage and operation of data, and provide information support for the realization of the intelligent function of Internet of Things equipment.

2.3. Application of "Industrial 4.0"

In the context of the implementation of Germany's "Industry 4.0" strategy, Siemens has launched a Totally Integrated Automation (TIA) system based on a unified management and standardized digital factory. The TIA system is the world's first software to integrate all automation tasks into one engineering design environment, including most of Siemens' product lines, and is a model for efficient collaboration of automation components.

First, implement unified data management. The high transparency of the recording and generation of all data during the operation of the equipment ensures the accuracy of management decisions and thus significantly increases the cost-effectiveness of the plant.

Second, follow a unified global standard. The communication integration of Siemens Digital Factory is based on international standards and enables flexible application across supplier standards. This unrestricted communication integration ensures efficient collaboration and high data transparency across all components of the hierarchy, that is to say, one can get relevant information at any time at anywhere in the factory.

Third, install a unified hardware and software interface. Siemens has set up a unified hardware and software interface for devices, which significantly shortens the system configuration time, cost and workload, thus greatly enhancing the competitiveness of the project and improving the profitability and market competitiveness of the product.
3. Reindustrialization in the US

3.1. Background

Before the financial crisis, the United States had already put forward the idea of advanced manufacturing technology and fully recognized the importance of manufacturing. In the 1990s, the United States began manufacturing information technology. In 1993, the US government began implementing the Advanced Manufacturing Technology (AMT) program to improve the competitiveness of US manufacturing by studying the world's leading advanced manufacturing technologies to meet the US demand for advanced manufacturing technologies. In 1994, the National Science and Technology Commission of the United States developed an AMT development strategy, supporting research institutes, universities, and industries to jointly develop advanced manufacturing technologies, and helping enterprises rapidly use advanced manufacturing technologies through industrial service networks to develop environmentally friendly manufacturing technology, actively implement education and training programs related to engineering design and manufacturing. In 1995, the US government launched a four-year strategic plan for agile manufacturing technology, investing $30 million annually. More than 3,000 private companies, 16 universities, and several government agencies participated in this program.

After the outbreak of the financial crisis, the optimization of the domestic industrial structure was put on the agenda by the US government in the post-financial crisis period, and the “re-industrialization” strategy was the focus of work, aiming to reinvigorate the manufacturing industry. In 2009, at the G20 summit in Pittsburgh, the speech of the US President kicked off the pre-industrialization and proposed measures to vigorously develop emerging industries, encourage technological innovation, and support the development of small and medium-sized enterprises to solve the trade deficit and domestic unemployment. Its essence lies in strengthening the basic position of the real economy, exploring new ways of economic growth, and squeezing out the pre-virtual economic bubble.

3.2. Adjustment of U.S. Foreign Trade Policy under the "Reindustrialization Strategy"

Historically, the United States has repeatedly provoked incidents and initiated trade wars against competitors, including: First, the trade war between the United States and the European Union. Simple trade barriers such as tariff barriers before World War II have become more complicated and concealed. “Anti-dumping” and “counter-subsidy” penalties, import quotas, import licenses, self-production ratio restrictions, and sanctions after investigations in accordance with domestic trade law provisions had become universal trade war initiatives, the means of trade war "progress" is obvious. Second, trade war between the United States and Japan. The United States used its powerful comprehensive national strength to launch trade strikes in the trade war. Although Japan has strong economic strength, the counter-measures are relatively simple and moderate, leading to the final result is naturally biased toward the United States. Third, the trade war between the United States and the former Soviet Union. This round of trade war between the United States and the Soviet Union has integrated the broader dimensions of diplomacy, politics, and culture. It has broken through the restrictions in the economic and financial fields. The trade war has broken through the economic sphere. Political wrestling has become the dominant factor, and it also reflects the toughness and flexibility of the US trade war.

In recent years, in the context of increasing global manufacturing competition, Sino-US trade frictions have intensified due to the economic interests of China and the United States, the return of US domestic trade protectionism, and the US strategic containment of China. In particular, after Trump took office, the trade protection tendency of the United States has obviously increased, and the frequency of trade frictions with trading partners has increased significantly. In 2018, the United States launched a trade investigation and implementation of tariff plans for China in order to further gain profits and suppress China. In this round of Sino-US trade disputes, the United States imposed sanctions on ZTE, and Canada’s request for the detention of Huawei’s CFO Meng Xizhou in response
to the United States became a typical event of concern in the trade war. Under the leadership of the United States, the actions of developed countries to crowd out Chinese high-tech enterprises tend to be frequent, which casts a shadow over China's manufacturing from a big country to a manufacturing power.

3.3. Development and Application of Industrial Internet under the Strategy of Reindustrialization

The fundamental feature of the current round of re-industrialization in the United States is "Internet + Industry", and the Internet is becoming a core force of driving industrial change. The "Internet + Industry" in the United States mainly solves three major problems: First, it solves the problem of power conversion. Although the US recovery situation is slightly better than Europe, it lacks new development momentum and the recovery momentum is not obvious enough. Second, it solves the problem of upgrading the industrial system. The re-industrialization of the United States is not a simple return of the real economy, but an upgrade of the real economy, mainly reflect on the upgrading of the industrial system, and the Internet is the basis and tool for upgrading. Third, it solves the problem of transformation of production methods. This new round of scientific and technological revolution will bring about revolutionary changes in production methods and marketing methods. Re-industrialization in a certain sense is a real industrial revolution.

GE's industrial Internet is a typical representative of the US "Internet + Industry" model. In 2012, in the era of digital industry, GE joint manufacturing and IT industries, proposed a strategic vision to restructure the global industrial system, worked together to build an industrial Internet, connected machines and advanced sensors, controls and software applications to improve production efficiency and reduce resource consumption. Compared with Germany's Industry 4.0, the US Industrial Internet pays more attention to the subversion of software, network, big data and other services for the industrial sector.

4. Artificial Intelligence in Japan

4.1. Background

Japan's manufacturing industry developed rapidly after the World War II. In the 1970s, industrial modernization was basically achieved. In the 1980s, it surpassed Europe, the United States and other industrial powers in the fields of automobiles and semiconductors, and became the world's second largest manufacturing country. Subsequently, the Japanese economy entered a period of stagnation, but its advanced manufacturing industry is still developing rapidly.

The Japanese government and the business community attach great importance to the important role of artificial intelligence in the development of advanced manufacturing. In 1992, Japan, the United States and Europe jointly proposed a cooperative system that would enable people and smart devices to be free from production operations and national boundaries. In 2015, Japanese government released the "New Robot Strategy", which proposed three core objectives of becoming the "World Robot Innovation Base", "The World's Largest Robot Application Country", and "Towards the World's Leading Robot New Era". Japan not only regards artificial intelligence and robots as the core of the fourth industrial revolution, but also establishes a relatively complete R&D promotion mechanism at the national level, aiming to maintain and enhance its absolute technology advantages in the fields of automobiles and robots by promoting the development of artificial intelligence, and, gradually solve social problems such as population aging and labor shortage.

4.2. Key Points of Artificial Intelligence Development

In order to meet the needs of industrial transformation and maintain its status as a “robot power”, Japan’s “White Paper on Manufacturing” take artificial intelligence to improve the application of robots in factories as technical points, and promote industrial technology level and industrial structure transformation and upgrading.
First, study the technology of "human, machine and information system" and the "artificial cerebellar function" device. Japan promotes the integration of robots and the Internet to improve the level of artificial intelligence of robots. Using Internet-based cloud computing and big data analysis to enhance the robot's cognitive and thinking ability, improve the level of robot intelligence, enable intelligent robots to perceive the surrounding environment in a timely manner, and automatically grasp new actions and quickly adapt to the requirements of "multiple Variety of small batch "production line.

Second, promote the "cloud" of the core device and operating system of the robot. With the openness of intelligent software and the involvement of robots in the "cloud" wave, robots do not need to build a large amount of intelligent software, and can be directly retrieved from the cloud when needed, thereby greatly reducing the price of robots and greatly accelerating the diffusion and popularization of robot technology. Through the network, the “experience” of a single robot is instantly shared with other robots, self-learning and experience accumulation are accelerated.

4.3. The popularization and application of artificial intelligence
Japan has vigorously promoted the application of artificial intelligence technology in manufacturing, and robots have rapidly spread in manufacturing factories. With the government's clear support and various subsidy policies, Japanese automakers such as Toyota continue to introduce new technologies through robotic R&D and application advantages, and apply technological results to automobile production and services to improve product performance and competitiveness.

First, increase foreign investment and cooperate in research and development of new technologies. Toyota attaches great importance to the research and development and introduction of new technologies, pays attention to the development of new technologies related to products, combines the characteristics of products and the needs of development, and adopts new methods of foreign investment. For example, Toyota Research Institute injected $100 million in original startup funding into Israel's Toyota AI Ventures for research in artificial intelligence, autonomous driving, and cloud computing.

Second, develop new robotics technology to broaden the market. Toyota is committed to the development of industrial robots. Under the premise of ensuring its leading position in automobile production and development technology, it develops partner robots that assist human work based on leading technology, expands the application range of advanced technologies, expands the types of products, and expands the market influence of brands. Currently, based on market demand, Toyota product development has gradually shifted to producing auxiliary robots that provide assistance to the elderly, the disabled, and medical personnel.

5. Conclusion and Suggestions
Germany, the United States and Japan are at the forefront of global intelligent manufacturing. Focusing on the deep integration of the Internet and industry, Germany has upgraded "Industry 4.0" to a national strategy, aiming to seize the opportunities in the new round of industrial revolution. The United States has placed a strategic vision of reconfiguring the global industrial system around the "advanced manufacturing plan" and the "industrial Internet". Japan is vigorously promoting the application of artificial intelligence technology in manufacturing. Treat robots as a breakthrough, upgrading the manufacturing pattern and improve the level of intelligent manufacturing.

Closely grasp the window of this new round of science and technology and industrial revolution and China's accelerated transformation of economic development mode, and draw on the experience of foreign developed countries, and make the following recommendations:

First, scientifically judge the situation and fully grasp the historical opportunity period of this new round of science and technology and industrial revolution. Germany firmly grasped the second industrial revolution opportunity period, vigorously developed a series of new industries such as power industry and electrical appliance manufacturing, and finally established the status of industrial power. At present, China's manufacturing industry is still in the stage of “big but not strong”, and there are widespread poor independent innovation capabilities, high dependence on core components,
unreasonable industrial structure, and outstanding product quality issues. This new round of science and technology and industrial revolution has formed a historic convergence with China's accelerated transformation of economic development mode. The development environment of China's advanced manufacturing industry has become more complex, requiring scientific analysis and accurate grasp of the new situation.

Second, closely follow the high-quality development requirements and strengthen the advanced manufacturing strategy to lead and promote development. Developed countries are promoting their advanced manufacturing concepts, models and standards on a global scale, such as Germany's "Industry 4.0" and GE "Industrial Internet". Compared with developed countries, Chinese enterprises still stay in the tactical operation level of imitation and follow-up in the concept of leading, cultivating and developing advanced manufacturing. They also need to further enhance the industry's right to speak at the strategic level and undertake more high-value activities in the industrial chain.

Third, closely integrate the needs of enterprise development and increase the policy support for high-tech enterprises. The carrier of the transformation and upgrading of the manufacturing industry is still the enterprise, and the state and the government must make good guidance and guarantee. At present, in this intricate international environment, seize the critical period of global economic restructuring and transformation, increase policy support for high-tech enterprises, comprehensively use policy measures such as tax reduction and fee reduction, increase investment to guide enterprises to expand production by extension, and pay attention to the intrinsic technology content and the development quality change is also the key to boosting the future transformation and development of China's manufacturing industry.

Acknowledgments
This paper is sponsored by National Natural Science Foundation (71701161).

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