

Research on Key Technologies for Value Chain Analysis and Optimization in Manufacturing Enterprises

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Abstract: By analyzing the connotation, system structure, typical characteristics, and main categories of modern manufacturing enterprise technology, the development status and direction of modern manufacturing technology in various countries around the world are summarized. Introduced the cutting-edge technology layout, enterprise applications, and industry value chain development of China's manufacturing powerhouse. On this basis, this project intends to propose several policy recommendations for the development of manufacturing enterprises in China, including promoting the development of intelligent manufacturing, strengthening basic scientific research, and establishing a group of advanced manufacturing clusters for independent research and development.

1. Technical status of manufacturing enterprises

As the foundation of national economic development, the technology of advanced manufacturing enterprises has become the main battlefield of national scientific and technological innovation. In recent years, a series of advanced manufacturing models such as modern integrated manufacturing, additive manufacturing, and intelligent manufacturing have emerged among manufacturing enterprises. For example, flexible manufacturing models aimed at meeting large-scale needs and personalized customization, biological manufacturing models that use biological functions for large-scale material processing and transformation, and basic research in core manufacturing fields such as biomedicine, new materials, and aerospace. Significant progress and progress in technology research and development, industrial application and cultivation will effectively promote the high-quality development of China's manufacturing industry. During the period from 2012 to 2021, the added value of China's manufacturing industry increased from 16.98 trillion yuan to 31.4 trillion yuan, and its global share also increased from 22.5% to nearly 30%. For 12 consecutive months, China's manufacturing industry remains the strongest [1]. China's 25 high-end manufacturing industry clusters, including equipment manufacturing, raw materials, and electronic information, achieved an industrial added value of 6.2 trillion yuan in the first half of 2022, providing strong value chain support for regional development[2]. In the context of a strong manufacturing country, exploring and analyzing the current development status of cutting-edge technologies in advanced manufacturing enterprises, and based on this, exploring ways to further promote the high-quality development of the manufacturing industry in the future, has both theoretical and practical value, and is also a hot topic of concern for researchers at present.

2. Analysis of Advanced Manufacturing Technology

In the late 1980s, the competitiveness of Western countries significantly weakened and the trade deficit was too large. Many advantageous industries gradually lost their competitiveness. In order to revive the manufacturing industry and change the decline of domestic manufacturing, the West invested a large amount of funds in researching advanced manufacturing technologies. In the early stage, it was proposed that advanced manufacturing technologies mainly include computer-aided design, computer-aided manufacturing, computer-aided engineering, robotics, and flexible manufacturing technology. Information technologies such as automatic control systems, numerical control technology, and equipment have subsequently been recognized and extended in various countries around the world, and relevant theoretical and practical applications have been studied. Throughout the historical process of the four industrial revolutions, from mechanized production, electrified production, automated production to intelligent production, advanced manufacturing technology has also developed with the progress of the industrial revolution [3]. Therefore, based on the traditional manufacturing technology, the advanced manufacturing technology fully absorbs the achievements in machinery, electronics, information, materials, energy and modern management, and applied in the product design, processing, testing, enterprise management, after service and recycling to achieve efficient, clean and flexible production. It improves the adaptability and competitiveness of enterprises to the dynamic market and realizes the construction and implementation of the value chain of manufacturing enterprises.

3. Advanced Foreign Systems

The scope of advanced manufacturing enterprise technology is very broad. Although the system structure varies in each country's technological evolution process, its essence is an organic combination of natural science, social science, economics, and management science. The American Society of Mechanical Engineers (ASME) was founded in 1880 and was the first to propose basic manufacturing technologies, new unit manufacturing technologies, and system integration technologies, forming a systematic classification of advanced manufacturing technologies (Figure 1) and as show in Table 1 ASME Advanced Manufacturing Technology Level Classification.



Figure 1: Manufacturing Technology Equipment

Table 1: ASME Advanced Manufacturing Technology Level Classification

Technical classification				
Emerging industries and market demand driven(Major equipment, high-tech industry, and coordinated development of society) Computer Integrated Manufacturing System	Additive manufacturing and precision new materials, nano Dense forming technology, rice technology, and lasers process technology	Systems Engineering and Management Science System Flexible Manufacturing Technology (Molecular Biology Robotics, Automation and Intelligence Low Consumption, Cleaning)	Basic manufacturing technology (high-quality, efficient, advanced electronic technology system, intelligent manufacturing information, and biological manufacturing technology)	New generation information technology, green and sustainable manufacturing integration technology, new energy technology, new material technology

3.1 Classification of Domestic Advanced Manufacturing Technology Levels

3.1.1 Basic processing techniques.

It is a traditional and economical basic technology that is still widely used today, such as precision casting, precision machining, precision measurement, etc. It also includes casting, forging, welding, etc. Heat treatment, surface protection, mechanical processing, etc. during the production process to achieve the goal of high quality, high efficiency, and low consumption; A clean basic production process is a key and critical link in modern production processes[4].

3.1.2 New processing device technology.

In industries such as new technologies, new materials, and new pharmaceuticals, industrial enterprises are facing new challenges. On this basis, the technical level of "new manufacturing units" represented by "additive manufacturing", "micro nano manufacturing", and "biomimetic manufacturing", and the technical level of "new manufacturing" centered on "new manufacturing units".

3.1.3 Information fusion technology.

The focus of this level is "aggregation", also known as "advanced production model/system", which refers to a modern comprehensive production model formed by combining various production unit technologies, enterprise management, machinery, electronics, information, etc; It has intersected with multiple other fields and combined sociology with economics, ultimately achieving commercial applications and industrial development[5]. Currently, with the support of high-tech represented by the new generation of information technology and intelligent manufacturing as an example, production has been carried out.

4. Suggestions for accelerating the high-quality development of the optimized technology industry

4.1 Promote intelligent production towards the development of high-end manufacturing technology

Making significant breakthroughs in major industries is a major measure to build a "manufacturing powerhouse". The United States has made significant progress in intelligent and digital manufacturing, advanced materials and process technology, and medical products. With IC design and production, food and agricultural product production as the core. Germany takes the construction and implementation of intelligent factories as the starting point, with a focus on promoting the application of information technology. Japan will focus on key technologies such as unmanned driving and robotics, and strengthen the implementation of the Internet of Things. China is a country of manufacturing industry and the Internet. Intelligence has become the leading direction and focus of the development of China's high-end manufacturing industry. China has a huge domestic market and relatively complete Industrial Internet and intelligent manufacturing. It has an once-in-a-lifetime historical opportunity to promote the digital, networked and intelligent development of manufacturing industry. The rapid development of information technology and its deep integration with the real economy have led to the emergence of new organizations, formats, and industries. With intelligent manufacturing as the main goal, we will accelerate research on core technologies and continuously improve the policy system for integrated development.

4.2 Building a world-class national laboratory and building an innovative highland for technology and industry

Both China's 14th Five Year Plan and the world's largest industrial country's use of laboratories to achieve a certain international leading position have demonstrated their significant impact on high-end manufacturing and other fields. To this end, China needs to innovate in ultra-precision machining technology, material forced forming technology, biomimetic manufacturing technology, and other aspects according to the structural layout of world advanced manufacturing technology; In the growing sub technology fields such as CNC machine tools, computer-aided design technology, and industrial robots, national laboratories are planned and a batch of forward-looking and strategic national major scientific and technological projects are implemented to accelerate the development of key core technologies and achieve breakthroughs in medical imaging detectors, high-end bearing steel, and aviation engines. In terms of operating systems, chips and high-end lithography machines independently developed in China, we will build an open, international oriented, world oriented, global oriented and future oriented high-end manufacturing technology research and development platform to provide strong technical support for the development of high-end manufacturing in China.

4.3 To promote strategic collaboration in key regions across the country and establish a regional strategic coordination mechanism for scientific and technological talents

By studying the technological innovation capabilities of the eastern, central, and western regions, we aim to promote the integration and complementarity of technological innovation capabilities in each region, forming a new collaborative development model for technological innovation capabilities, effectively controlling the "big city disease" and enhancing regional technological innovation capabilities. At the same time, in the context of economic globalization, the status of China's manufacturing industry in the international arena is constantly improving, and its position in the international arena is also constantly improving. The United States suppresses the export of

Chinese goods through various means and often triggers trade disputes to restrict China's production (especially high-end goods), especially the development of high-end goods. The United States, on the other hand, expands its international market by improving technology through both internal and external factors.

4.4 Financial and Policy Support

One is to actively seek national support and implement relevant tax and fiscal incentives and subsidies policies. Introduce tax preferential policies, vigorously reduce taxes and fees, and ensure that enterprises in our province enjoy a more fair and reasonable tax burden than other pilot provinces and cities. The manufacturing industry is implementing targeted tax reductions, and it is recommended to refer to the practices of advanced provinces and cities, with a tax reduction rate of no less than 5%. In response to the issue of enterprise R&D deduction, we have introduced detailed rules to strengthen the operation of enterprise R&D expense deduction, and expanded the scope of enterprises that can enjoy income tax deduction. It is recommended to increase the proportion of R&D expense deduction from the current 75% to 100%. The investment in intelligent manufacturing transformation of rapidly transforming enterprises is included in the R&D investment and enjoys additional deduction of income tax. Reduce the burden of five insurances and one fund for intelligent manufacturing transformation enterprises. Referring to the policy of paying five insurances and one fund in coastal areas, we will introduce a reference rate upper limit for the proportion of enterprise five insurances and one fund contributions, and clarify operational standards. Establish a special fund for intelligent manufacturing. We will support the enterprises to implement intelligent manufacturing projects through various methods such as free funding, loan interest discounts, paid use, and entrusted investment. The fourth is to innovate the methods of financial support, gradually shifting from "pre subsidy" to "post reward". Provide certain rewards to enterprises that carry out intelligent transformation and achieve outstanding business performance. Increase financial support. For intelligent equipment projects with advanced technology, obvious advantages, and strong driving and supporting effects, priority should be given to credit support, and financing "green channels" should be established, with preferential treatment given to loan quotas, terms, and interest rates. By establishing an insurance mechanism for domestic intelligent equipment products, the government could provide appropriate premium subsidies to establish a multi-party sharing financing mechanism and set up an intelligent manufacturing industry fund to encourage financial capital for the company. And the government can also develop a debt investment program to extend the investment period and use funds such as social security funds, insurance funds for infrastructure with stable returns and long payback period. At the same time, enterprises could use corporate bonds, project revenue bonds, corporate bonds and medium-term notes to encourage social capital to invest in regional industrial investment projects to raise funds for intelligent manufacturing construction projects, such as information infrastructure construction, intelligent manufacturing technology development, enterprise equipment transformation.

5. Conclusion

By analyzing the level of technology at home and abroad and understanding the differences between external and internal factors, the manufacturing industry of Chinese enterprises should accelerate its improvement, mainly because Chinese enterprises are facing higher external competitive pressures. Therefore, in the new situation, China should not only absorb advanced external technology, but also improve its enterprise value chain and actively introduce foreign investment to develop its own patented technology; Breaking away from high dependence on imports is the focus of the current manufacturing transformation and upgrading driven by enterprise value

chain upgrading and technological innovation.

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