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Pathways and Strategies for Enhancing the Global Value Chain Position of China's Pharmaceutical Industry

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Abstract: Although China's pharmaceutical industry industry has shown a leading momentum in some fields, it is still in the relatively low-end position of the global value chain, which is mainly restricted by the shortcomings of research and development capacity, the limitation of policy environment, the slow industrialization process and the gradual weakening of cost advantage. From the perspective of global value chain, this paper discusses the current development trend and internal characteristics of pharmaceutical manufacturing industry, as well as the possible path and strategy to improve its status. Based on this, this paper puts forward the path and strategy of upgrading the global value chain of pharmaceutical manufacturing industry, so as to improve its position and competitiveness in the global value chain.

1. Introduction

Since the outbreak of COVID-19 at the end of 2019, the rapid growth of residents' demand for pharmaceutical manufacturing products has driven the rapid development of China's pharmaceutical manufacturing industry. The large demand for medical resources and drugs during the epidemic has directly stimulated the development of pharmaceutical manufacturing. With the global focus on epidemic prevention and control, countries have increased their investment in pharmaceutical R&D and production, which has also indirectly promoted the rapid development of China's pharmaceutical manufacturing industry.

In 2023, the added value of China's pharmaceutical industry above designated size will reach about 1.3 trillion yuan. During the same period, the total operating revenue of enterprises above designated size was 2,955.25 billion yuan, a figure that has increased by nearly 800 billion yuan over the past decade; Total profits doubled in a decade, to 412.72 billion yuan. These figures show that China's pharmaceutical industry is not only expanding in size, but also rapidly improving in profitability.

The rapid development of pharmaceutical manufacturing is not only reflected in the export of traditional apis and generic drugs, but also in the fields of vaccines and bioinnovative drugs. Research based on patent analysis and bibliometrics shows that China's pharmaceutical manufacturing industry is in a stage of rapid development, especially in the fields of vaccines and bioinnovative drugs. [1] In recent years, the problems and constraints existing in the development of China's pharmaceutical manufacturing industry are highlighted in the weak research and

development ability, low industry concentration, low level of industrialization, and the gradual loss of cost advantages. [2] Therefore, how to further promote the high-quality development of pharmaceutical manufacturing industry, which itself has important theoretical and practical significance. Studying China's pharmaceutical manufacturing industry under the framework of global value chain has important theoretical value and practical significance for promoting the status of pharmaceutical manufacturing industry value chain and forming global competitiveness.

2. Development Status, Position in the Global Value Chain, and Constraining Factors

2.1. Current Status of Industrial Development and Position in the Global Value Chain

Table 1: Top 20 listed biopharmaceutical companies in China by market value in 2023

Unit: Billion RMB

Rank	Company	Market Value	Market Segment	Rank	Company	Market Value	Market Segment
1	Chongqing Zhifei Biological Products Co.,Ltd.	1466.64	Vaccines	11	Pacific Shuanglin Bio-pharmacy Co., LTD	199.57	Blood Products
2	Beijing Wantai Biological Pharmacy Enterprise Co., Ltd.	952.80	Vaccines	12	Liaoning Cheng Da Co.,Ltd.	180.20	Vaccines
3	Changchun High-Tech Industries (Group) Inc.	589.99	Vaccines, Genetic Engineering	13	Anhui Anke Biotechnology(Group)Co.,Ltd	171.37	Antibodies, Polypeptides
4	Shanghai RAAS Blood Products Co., Ltd.	531.64	Blood Products	14	China Resources Boya Bio-pharmaceutical Group Co.,Ltd	169.83	Blood Products
5	Beijing Tiantan Biological Products Corporation Limited	509.83	Blood Products	15	Hualan Biological Vaccine Inc.	166.80	Vaccines
6	HUALAN BIOLOGICAL ENGINEERING,INC.	404.71	Blood Products	16	Zhejiang Wolwo Bio-Pharmaceutical Co., Ltd.	151.84	Diagnostic Reagents
7	Walvax Biotechnology Co., Ltd.	377.89	Vaccines	17	Rhodiola Pharmaceutical Holding Co.	120.99	Polypeptides
8	Gan & Lee Pharmaceuticals.	312.83	Insulin	18	Sino Biological,Inc.	106.46	Recombinant Proteins
9	Shenzhen Kangtai Biological Products Co.,Ltd.	303.24	Vaccines	19	Beijing SL Pharmaceutical Co., Ltd.	104.69	Cytokines
10	Tonghua Dongbao Pharmaceutical Co.,Ltd.	215.91	Insulin	20	Chengdu Kanghua Biological Products Co., Ltd.	104.41	Vaccines

Source: Wind

Up to now, China's biomedical manufacturing industry has built a relatively complete industrial chain, and Chinese pharmaceutical enterprises have the ability to produce all kinds of commonly used drugs, vaccines, biological agents and medical devices. From the perspective of each link of the industrial chain: in the field of upstream R&D, many small and medium-sized pharmaceutical companies play the role of providing professional R&D services for large pharmaceutical companies, injecting innovation vitality into the whole industry. A number of large biopharmaceutical enterprises with strong international competitiveness have emerged in the middle

of the production process. However, it is also necessary to pay attention to the unbalanced industrial structure, which is manifested as the coexistence of low-end drug overcapacity and high-end drug undercapacity. The downstream circulation and sales link is relatively the weak link of the industrial chain. However, with the gradual relaxation of the policy environment, the biomedical distribution industry is expected to usher in an opportunity to accelerate development. In the future, with the gradual relaxation of the policy environment and the development of industrial clusters, it is expected to further enhance the synergy efficiency and market competitiveness of the whole industrial chain. The top 20 listed biomedical enterprises in China in 2023 are shown in Table 1.

Although China's biopharmaceutical industry started relatively late, its development speed is very rapid, and the market value of listed companies has increased significantly. In recent years, China's biopharmaceutical industry has maintained a strong momentum of growth, benefiting from the enhancement of national purchasing power, the rapid expansion of downstream demand market, the promotion of national biological industry development plan and the significant improvement of biotechnology level. At the same time, the prosperity and development of emerging industries such as personalized medicine, digital medicine and in-vitro diagnosis have injected new vitality into the biomedical manufacturing industry. In addition, the continuous introduction of favorable policies at the national level also provides strong support for the further development of the industry. [3] Based on the above considerations, the industry is generally optimistic about the future development prospects of biomedical manufacturing, which is expected to continue to maintain rapid growth and occupy an increasingly important position in the global biomedical field. As of July 31, 2023, chemical pharmaceutical, medical device, biological products market value ranked first. Before 2019, the market value of listed biologics companies was close to 500 billion yuan, but grew rapidly to about 1.8 billion yuan in 2019-2020, and remained above 1 trillion yuan after the end of the epidemic.

2.2. Constraining Factors

China's pharmaceutical industry is still facing multidimensional challenges as it strives to catch up with the forefront of global pharmaceutical technology. These challenges include the shortcomings of R&D capacity, the limitations of the policy environment, the slow industrialization process and the gradual weakening of the cost advantage. They are intertwined and profoundly affect the long-term prosperity of China's biomedical manufacturing industry.

R&D innovation capacity needs to be strengthened, including the scale of R&D investment, the subject of patent application, and the lack of R&D talents. There is a significant gap between Chinese biomedical enterprises and the world's top enterprises in R&D capital investment and innovation output. The annual R&D investment of global pharmaceutical giants generally exceeds 10 billion US dollars, and although China is in a leading position in technological development in some fields, such as Guangdong and Jiangsu [4], there is still a huge gap between China and developed countries in terms of overall R&D investment intensity [5]. Although the biomedicine patent application is active in our country, the pharmaceutical enterprises have not become the main applicant of the invention patent compared with foreign countries. [6] In addition, the lack of high-end R&D talents is also a limiting factor. Although there is a return of overseas talents, the training cycle of interdisciplinary talents is long, and the innovation ability of grassroots R&D teams urgently needs to be improved. [7]

The policy framework and incentive mechanism are not yet sound. The imperfect policy and system not only weaken the innovation incentive of enterprises, but also affect the stability of product supply and the release of market demand. Problems such as the lag of updating the medical insurance reimbursement catalog and the imperfect policy of centralized bidding and procurement

of drugs have seriously affected the innovation and development of the pharmaceutical industry. [8] In addition, the obstacles for innovative drugs to enter the medical insurance list include that the selection basis of the medical insurance list is not objective enough, and the review results are easily affected by individuals' subjective will. [9] The limitations of the medical insurance payment system, especially the limited ability of medical insurance payment and the strictness of price negotiation, limit the pricing space of innovative drugs and further compress the profit space of enterprises. The uniformity of payment methods also inhibits consumers' willingness to pay for high-priced innovative drugs, affecting market demand. [10] In addition, the high cost, long cycle and high risk of new drug development lead to a sharp rise in R&D costs, while the success rate of compound marketing is less than 1/5000. The complex process of new drug development and low success rate, coupled with the lack of Chinese biomedical enterprises in the construction of a high-return environment, make financing more difficult. Financing has become a major challenge for biomedical enterprises, especially for those enterprises with certain drug research and development strength but difficult to obtain the needed research and development funds from sales revenue.

The industrialization process lags behind. The industrialization of biotechnology in China is relatively slow, which is mainly restricted by the dependence on import of equipment and technology and the lack of close integration of production and research. The import dependence of key production equipment and technology not only increases costs, but also limits the speed and scale of industrialization. At the same time, although there is little gap between China and the international level in the stage of laboratory research and development, there are obvious shortcomings in the transformation of achievements and mass production, and the gap between production and research is serious. [11] In addition, the lack of infrastructure such as biosafety laboratories also restricts the further industrial application of biotechnology.

The cost advantage is weakening and the international competitiveness is facing challenges. In the global pharmaceutical market competition, the cost advantage that Chinese pharmaceutical companies originally relied on is gradually losing. On the one hand, international pharmaceutical companies have accelerated their layout in China and transferred core links such as R&D and production to China, which has intensified the competition in the local market. On the other hand, the cost of developing new drugs has soared, undermining cost competitiveness. In the face of this situation, Chinese pharmaceutical enterprises urgently need to explore new competitive advantages to cope with the increasingly fierce international competition and ensure a solid position in the global pharmaceutical manufacturing chain.

3. Characteristics of the Global Value Chain in Pharmaceutical Industry

mRNA vaccine is a new vaccine technology. By injecting mRNA encoding protein information of pathogen into the body, the host cell's own protein synthesis mechanism is used to generate antigen, so as to trigger immune response and achieve the purpose of disease prevention. mRNA vaccines have shown significant and far-reaching positive effects on reducing COVID-19 incidence and related mortality in widely vaccinated groups. [12] COVID-19 vaccines developed by Pfizer, Moderna and other companies using mRNA technology were developed, produced and vaccinated on a large scale in a short period of time, making important contributions to the global fight against the pandemic. mRNA vaccines also herald potential changes in future vaccine strategies, marking the arrival of a true revolution in medical technology innovation. [12]

It can be seen that technological progress, especially major innovation in biotechnology, has become the core driving force for the leapfrog development of biomedical manufacturing. Looking back at history, the three breakthroughs in the field of biopharmaceutical are all rooted in the leap of technology. These advances not only gave birth to many epoch-making drugs and profoundly

changed the medical field, but also created huge economic value for enterprises and wrote legendary stories one by one. At the same time, as the core of the industrial value chain, R&D continues to promote technological progress and industrialization process, among which drug discovery is particularly key and makes a significant contribution to the value chain. [13] Every time there is a major breakthrough in biotechnology, the biopharmaceutical industry will usher in a new leap. In addition, policy support is an important guarantee to promote the upgrading of the value chain. Governments have created a favorable environment for the prosperity of the biomedical manufacturing industry through diversified policies and regulations, such as expanding R&D funds, setting up government-guided investment funds, providing tax incentives, strengthening technical support and improving patent protection. [14] Taking China as an example, through active layout in the field of biological industry, a series of targeted support policies and long-term development plans have been formulated, creating favorable conditions for the prosperity of the industry. Specific policy details and planning content can be found in Table 2.

Table 2: Supportive policies and plans related to the biological industry in China

Release Date	Policy Name
March, 2021	"The 14th Five-Year Plan for National Economic and Social Development of the People's Republic of China and the Long-Range Objectives Through the Year 2035"
March, 2021	"The '14th Five-Year' Plan for the Development of the Biopharmaceutical Manufacturing Industry"
May, 2021	"Implementation Opinions on Comprehensively Strengthening the Capacity of Drug Supervision"
December, 2021	"The '14th Five-Year' National Plan for Drug Safety and Promoting High-Quality Development"
January, 2022	"The '14th Five-Year' Plan for the Development of the Pharmaceutical Industry"
May, 2022	"The '14th Five-Year' Plan for the Development of the Bioeconomy"
May, 2022	"The '14th Five-Year' Plan for National Health"
August, 2023	"Opinions of the State Council on Further Optimizing the Foreign Investment Environment and Intensifying Efforts to Attract Foreign Investment"

The profit distribution of the biomedical manufacturing industry follows the "smile curve", and the high rate of return makes it a representative of the highly profitable industry, but the profit distribution of each link of the value chain is not balanced. Drug development and sales occupy both ends of the value chain and are the most profitable, while drug manufacturing is at the bottom of the curve and relatively less profitable.

In the process of drug R&D, technology transfer and strategic alliance have become the main means of value creation. This is not only because these activities can help enterprises stay ahead in the fierce market competition, but also because they can maximize value by obtaining high patent profits. [15] Research on strategic alliances shows that pharmaceutical enterprises can effectively create value by establishing R&D strategic alliances. [16] And the aggregation effect of geographical clusters and cooperative networks also has a positive impact on innovation performance. [17] In the manufacturing process, large pharmaceutical enterprises often adopt outsourcing strategies to reduce costs and focus on improving their core competitiveness. [18][19] This practice helps firms focus their resources on more profitable areas, such as research and development and marketing. At the same time, it also reflects the tendency of pharmaceutical companies in developed countries to outsource non-superior links to developing countries by optimizing resource allocation under the global value chain. In the sales process, pharmaceutical enterprises dominate the market, and independent research and development companies also actively expand the sales field to seek new growth points. For example, integration through mergers and acquisitions, strategic alliances and other ways is an important part of the pharmaceutical industry value chain characteristics and integration mode.

In the face of global competition, a few developed countries take the lead in all stages of drug R&D by virtue of their technological advantages, and hold a conservative attitude towards manufacturing outsourcing due to the continuous characteristics of drug production. In contrast, developing countries integrate into the global vertical specialization with low cost and low profit strategy, and achieve limited connection with the international market. With the deepening of economic globalization, developed countries outsource non-superior links to developing countries or regions in order to enhance competitiveness and optimize resource allocation, which further consolidates the division of labor pattern of global biomedical manufacturing industry. This trend is not only reflected in the chemical pharmaceutical industry, but also in the biopharmaceutical industry chain. [20]

4. Pathways to Enhance the Position of Pharmaceutical Industry in the Global Value Chain

First, strengthen the upgrading path of innovation-driven and R&D investment. China's pharmaceutical manufacturing industry has some deficiencies in international competitiveness, especially in the field of high-end products. Therefore, increasing R&D investment and strengthening independent innovation capability are the key to promoting the position of global value chain. By optimizing foreign capital introduction policies, we will attract multinational pharmaceutical enterprises with advanced technology and management experience to settle in. [21] In this process, we should not only pay attention to the scale of foreign direct investment, but also pay attention to the evaluation of its technical content to ensure the advancement and applicability of technology import. At the same time, we will establish and improve the technology digestion, absorption and re-innovation mechanism, encourage local pharmaceutical enterprises to improve the digestion ability and secondary innovation ability of imported technology through joint research and development and technical cooperation, and form a core technology system with independent intellectual property rights. [22]

Second, industrial structure optimization and industrial chain upgrading path. In view of the current problems of high upstream degree, unreasonable export structure and low industrial concentration in China's pharmaceutical manufacturing industry, the strategy of industrial structure optimization and industrial chain upgrading should be actively implemented. By adjusting the industrial structure, the Company promoted the extension of the industrial chain to high value-added and high-tech biopharma, high-tech drugs and other fields, so as to enhance the competitiveness of the whole industrial chain. At the same time, it is necessary to strengthen the coordination and cooperation between the upstream and downstream of the industrial chain, promote the efficient allocation of resources, and improve the industrial autonomy, so as to realize the leap in the global value chain. [23]

Third, deepen international cooperation and market expansion. China's pharmaceutical industry should grasp the opportunity of the rapid growth of the global pharmaceutical market, deepen international cooperation, and actively explore the international market. By establishing strategic partnerships with international pharmaceutical giants, participating in international project cooperation and standard formulation, and introducing international advanced management concepts and technologies, the Company accelerated its own development. At the same time, Chinese pharmaceutical manufacturers have strengthened international market promotion, expanded the international market share of Chinese pharmaceutical products, enhanced international brand awareness and strengthened their voice in the global pharmaceutical market.

The fourth is to promote the upgrading path of diversified and networked global production. In view of the complexity and variability of the global production system, the pharmaceutical manufacturing industry should implement a diversified and networked global production strategy.

This includes optimizing the layout of global production and rationally allocating resources according to the comparative advantages of different regions; Strengthening supply chain management and risk management to ensure the stability and resilience of supply chains; The overall pharmaceutical manufacturing industry needs to promote digital transformation and intelligent manufacturing to improve production efficiency and product quality; strengthen cooperation with multinational logistics companies and international organisations to build an efficient and convenient global logistics network.

Fifth, we will improve policy support and incentive mechanisms for upgrading. We should continue to improve the policy environment conducive to the development of pharmaceutical manufacturing industry and establish a sound incentive mechanism. By providing financial subsidies, tax incentives and other policies and measures, we will reduce the operating costs of enterprises and stimulate their innovation vitality. [24] At the same time, the protection of intellectual property rights should be strengthened to ensure the innovation achievements of enterprises and create a fair market environment for enterprises. In addition, it is necessary to accelerate product quality upgrading in key areas, consolidate the foundation of API industry, implement the strategy of preparation internationalization, and provide solid policy support for promoting the position of China's pharmaceutical manufacturing industry in the global value chain. [25]

5. Strategies for Enhancing the Position of Pharmaceutical Industry in the Global Value Chain

The current position of China's pharmaceutical manufacturing industry in the global value chain is generally low. The industry faces multiple institutional difficulties that hinder its promotion in the global value chain. In order to promote industrial upgrading and transformation, relevant parties should actively assist enterprises to overcome the upgrading bottleneck that is difficult to break through by themselves.

First, we will strengthen innovation and research and development capabilities to drive high-quality industrial development. The primary task of the transformation and upgrading of pharmaceutical manufacturing industry is to strengthen innovation and research and development capacity, which is the key to enhance the core competitiveness. Enterprises should focus on the research and development of new drugs with independent intellectual property rights, covering chemical drugs, proprietary Chinese drugs and biological drugs and other fields, to form diversified product lines. By increasing R&D investment, especially in-depth exploration in the field of biomedicines, it can not only accelerate the marketing process of new drugs, but also promote the secondary development of traditional Chinese medicine and tap the modern value of traditional medicine. At the same time, combined with the national policy guidance and the characteristics of China's industry during the "14th Five-Year Plan" period, the development strategic plan is put forward from the macro level to point out the development direction of the pharmaceutical manufacturing industry and help it achieve the goal of industrial upgrading and internationalization as soon as possible.

Second, pharmaceutical manufacturers promote intelligent manufacturing and digital transformation, leading the transformation of manufacturing mode. Under the wave of intelligent manufacturing and digital transformation, the pharmaceutical manufacturing industry needs to actively embrace new technologies to realize the fundamental change of production mode. This includes establishing an awareness system for intelligent manufacturing, selecting appropriate digital models and algorithms, and using advanced technologies such as artificial intelligence, machine learning, Internet of Things (IoT) and big data analytics to optimize production processes,

improve production efficiency and product quality, and reduce operating costs. The traditional Chinese medicine industry also needs to keep up with the pace of The Times, move forward from digital pharmaceutical to intelligent pharmaceutical, improve the standardization and homogenization level of traditional Chinese medicine preparations through intelligent means, and promote the modernization of traditional Chinese medicine.

Third, we will optimize the industrial structure and raise the added value of products and the level of green development. The transformation and upgrading of pharmaceutical manufacturing industry also needs to pay attention to the optimization and adjustment of industrial structure. Through the upgrading of technological structure, we will promote the transformation of economic development mode from extensive to intensive, and promote the optimization and upgrading of industrial structure. In this process, we should vigorously develop high value-added industries, reduce the proportion of production capacity with high pollution and low benefit, adhere to the concept of green development, and build a resource-saving and environment-friendly modern pharmaceutical manufacturing system. At the same time, in view of the industry changes brought by policies such as purchasing with volume, enterprises need to deeply analyze market trends, accurately position themselves, and adopt flexible and diversified competitive strategies to cope with market challenges.

Fourth, China's pharmaceutical industry should accelerate the internationalization process and expand the market width. Internationalization is an important direction of the transformation and upgrading of pharmaceutical manufacturing industry. Enterprises should actively implement the internationalization strategy of preparations, speed up the quality upgrading of products in key areas, and enhance the international competitiveness. Pharmaceutical manufacturers ensure supply chain stability and security by strengthening the API industrial base. At the same time, it will increase research and development efforts in key technical fields, cultivate modern proprietary Chinese medicine that meets international quality standards, break down international market barriers, and promote the internationalization process of Chinese medicine. In addition, by summarizing successful cases at home and abroad, the key elements and paths of industrial upgrading are extracted, and a replicable and promotable "practice guide" is formed to provide valuable experience and reference for the industry.

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