Analysis of Chinese Patent Technology in Ship and Marine Engineering Equipment Industry

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ABSTRACT. Based on the current situation of China's shipbuilding and marine engineering equipment industry, this paper divides the shipbuilding industry into three categories: general-purpose shipbuilding industry, special-purpose shipbuilding industry and marine engineering equipment industry. Patsnap patent search platform is used to analyze the patent trend, distribution of key technology branches and key applicants of the three types of shipbuilding industry in China. According to the analysis results, the corresponding policy strategies are put forward to provide reference for enterprises to accurately grasp the future direction of development and avoid patent risks.

1. Introduction
We should conscientiously implement the spirit of the Central Economic Work Conference and grasp the five major tasks of "three go, one fall and one subsidy". To achieve continuous improvement of industrial concentration, gradual improvement of scientific and technological innovation capability, effective resolution of excess production, remediation of shortcomings in industry development, solid promotion of cost reduction and efficiency enhancement, steady development of international capacity cooperation, and further consolidation of the position of a major shipbuilding country [2]. However, influenced by the continuous and deep adjustment of the international shipping market [3], the competition among China's key shipbuilding enterprises is more intense, and the situation facing the shipbuilding industry is more severe [4-5]. Therefore, it is particularly important for enterprises to grasp the future development direction by analyzing the current development status of patents in the field of ship and offshore engineering.

This paper divides the ship and marine engineering equipment industry into three categories: general-purpose ship industry, special-purpose ship industry and marine engineering industry. Based on Patsnap patent search platform, this paper analyses the patent situation in China's ship and marine engineering field, and focuses on the trend of patent application in key provinces and municipalities, key technical branches and key applicants in the three types of ship field. Advantages and weaknesses of the development of China's ship industry, and the corresponding policy recommendations are put forward in view of the weaknesses, which is conducive to the future direction of development of enterprises, and promote the sustainable development of China's ship and marine engineering equipment.
2. Analysis of Patent Application Quantity in Key Provinces

2.1 General Purpose Ship Field
The number of patent applications in general-purpose ships in key provinces in China is counted, and the patent applications and patent authorization of inventions in major provinces and municipalities are clarified.

Table 1 Quantity of patent applications filed by key provinces in the field of General Purpose Ships

| Number | Applicant Provincial | Number of Patents | MAP |
|--------|----------------------|-------------------|-----|
| 1      | Jiangsu              | 49728             |     |
| 2      | Guangdong            | 35701             |     |
| 3      | Zhejiang             | 28819             |     |
| 4      | Shandong             | 22057             |     |
| 5      | Shanghai             | 20513             |     |
| 6      | Liaoning             | 11148             |     |
| 7      | Hubei                | 9820              |     |
| 8      | Tianjin              | 9614              |     |
| 9      | Fujian               | 8339              |     |

From Table 1, we can know the patent application situation of Jiangsu Province, Zhejiang Province, Guangdong Province, Shanghai and other domestic economically and technologically advanced provinces and cities in the field of general purpose ships. In the field of general purpose ships, Jiangsu Province, Guangdong Province and Zhejiang Province ranked the top three in the number of patent applications, with 49,728, 35,701 and 28,819 applications, accounting for 23.83%, 17.11% and 13.81% respectively. The number of patent applications in Shandong, Shanghai and Liaoning provinces were 22,057, 20,513 and 11,148, accounting for 10.57%, 9.83% and 5.34% of the total number of applications in China, respectively. Jiangsu Province ranks first in the number of patent applications in China, and the number of patent applications in Jiangsu Province is almost equal to that in Zhejiang Province and Shandong Province.

Generally speaking, the patent application situation is consistent with the economic and technological development of the provinces and cities in China, and often has a certain inheritance relationship with the historical development of the shipbuilding industry of the provinces and cities. Jiangsu has a traditional experience in the development of the shipping industry in Chinese history. At present, the number of enterprises engaged in the shipping industry in Jiangsu Province is also relatively ahead of other provinces and cities in China.

2.2 Special Purpose Ships
Table 2 Number of patent applications from key provinces and municipalities in the field of special-purpose ships

| Number | Applicant Provincial | Number of Patents | MAP |
|--------|----------------------|-------------------|-----|
| 1      | Jiangsu              | 4029              |     |
| 2      | Zhejiang             | 2759              |     |
| 3      | Shanghai             | 2308              |     |
| 4      | Guangdong            | 2107              |     |
| 5      | Shandong             | 1524              |     |
| 6      | Hubei                | 1210              |     |
| 7      | Liaoning             | 1188              |     |
| 8      | Fujian               | 612               |     |
| 9      | Tianjin              | 585               |     |
From Table 2, we can see the patent application situation of Jiangsu, Zhejiang, Guangdong, Shanghai and other provinces with more developed economy and technology in the field of special purpose ships. In the field of special-purpose ships, Jiangsu, Zhejiang and Shanghai rank the top three in the number of patent applications, with 4029, 2759 and 2308 applications respectively, accounting for 16.9%, 11.6% and 9.7% of the total number of applications nationwide. In Guangdong, Shandong and Hubei provinces, the number of patent applications was 2107, 1524 and 1210 respectively, accounting for 8.8%, 6.4% and 5.1% of the total number of applications in China. Jiangsu, Zhejiang and Shanghai rank among the top three in the number of patent applications in China, and the total number of applications accounted for 38% of the total number of applications in China.

2.3 Marine Engineering Equipment Industry

Table 3Quantity of patent applications of key provinces and municipalities in marine engineering equipment industry

| Number | Applicant Provincial | Number of Patents | MAP |
|--------|----------------------|------------------|-----|
| 1      | Jiangsu              | 37224            |     |
| 2      | Shandong             | 24729            |     |
| 3      | Zhejiang             | 21468            |     |
| 4      | Guangdong            | 20852            |     |
| 5      | Shanghai             | 15333            |     |
| 6      | Liaoning             | 10726            |     |
| 7      | Tianjin              | 10698            |     |
| 8      | Hubei                | 9386             |     |
| 9      | Fujian               | 6545             |     |

From Table 5 and Figure 5, it can be seen that Jiangsu, Shandong and Zhejiang are among the top patent applications in the marine engineering equipment industry, with 37,224, 24,729 and 21,468 applications respectively, accounting for 12.8%, 8.5% and 7.4% of the total applications in China. The patent applications of Guangdong, Shanghai and Liaoning provinces and municipalities were 20,852, 15,333 and 10,726 respectively, accounting for 7.1%, 5.3% and 3.7% of the total applications in China. Jiangsu Province ranks first in the number of patent applications. Its patent application amount is 1.5 times that of Shandong Province and 1.7 times that of Zhejiang Province. The number of patents in Jiangsu Province is much higher than that of other provinces and cities.

3. The Annual Change of Patent Application Amount in Key Provinces

3.1 General Purpose Ship Field

Fig. 1Annual variation of patent applications in key provinces of General Purpose Ships

Figure 1 shows that in the past 20 years, the number of patent applications in general-purpose ships in key provinces in China has been increasing year by year. Before 2003, the growth rate of patent applications in all provinces was not obvious. From 2003 to 2011, the number of patent applications in all provinces increased significantly. From 2012 to now, the number of patent applications in all provinces has shown an explosive growth. The increase of patent applications in
Jiangsu Province is the most dramatic, with a larger increase. The increase of patent applications in Zhejiang, Guangdong and Shandong provinces is more obvious than that in other provinces and cities, while the increase of patent applications in Liaoning and Hubei provinces is relatively flat, and the annual change of patent applications is not obvious.

3.2 Special Purpose Ships

Fig. 2 Annual variation of patent applications in key provinces of special-purpose ships

From Figure 2, we can see that the number of patent applications in nine key provinces has increased year by year. The growth rate of patent applications in the provinces before 2008 is not obvious, and the number of patent applications in the provinces between 2008 and 2016 has increased significantly. Among them, Jiangsu Province has the fastest increase in the number of patent applications. The increase of patent applications in Zhejiang and Shanghai is also obvious. According to the changing trend of annual application volume, Jiangsu, Zhejiang and Shanghai attach great importance to this field of technology. The increase of patent applications in Tianjin, Fujian and Liaoning provinces is relatively low, and these provinces and municipalities need to pay more attention to the technology in this field.

3.3 Marine Engineering Equipment Industry

Fig. 3 Annual variation of patent application volume in key provinces of marine engineering equipment industry

Figure 3 shows that the trend of patent application in marine engineering equipment industry of key provinces in China in the past 20 years is similar to that of general-purpose ships and special-purpose ships. Before 2010, the growth rate of patent application in each province is not obvious. From 2011 to 2013, the number of patent applications in each province began to increase significantly. From 2013 to now, the number of patent applications in each province has shown an explosive increase in general. Long. From the figure, it can be clearly seen that the growth of patent applications in Jiangsu Province is the most obvious than other provinces and cities. In 2013, Jiangsu Province formally entered the development period, and showed a rapid development momentum. The growth rate of patent applications in Jiangsu Province is ahead of other provinces and cities in China.

4. Distribution of Key Technologies in China

4.1 General Purpose Ship Field
As can be seen from Fig. 4, the key technologies in the field of general purpose ships are mainly divided into four categories: hull structure, ship power plant, ship equipment and ship auxiliary equipment. The patent amount of ship equipment category is the most concentrated, accounting for 56.93% of the patent application amount, followed by ship auxiliary equipment and ship power plant, accounting for 17.1% and 15.6% respectively. The analysis shows that in recent years, due to hull structure and initiative, ship auxiliary equipment and ship power plant account for 17.1% and 15.6% respectively. The technology of the branch of equipment and auxiliary power equipment has been mature and the attention has been weakened, while other auxiliary machinery and equipment are the research hotspots in recent years. Although the development in the field of general-purpose ships is relatively late, it develops rapidly.

4.2 Special Purpose Ships

As can be seen from Figure 5, the key technologies in the field of special-purpose vessels are mainly divided into two categories: fishery vessels and professional engineering vessels. The number of patent applications of fishery vessels in China is slightly higher than that of professional engineering vessels, accounting for 55% and 45% respectively.

Traditional fishing vessels and fishery auxiliary vessels still maintain a large application base in the field of special vessels, but in recent years, the trend of their patent applications has slowed down year by year, and their related technologies have been in a relatively perfect stage. In recent years, the number of patent applications for professional engineering ship technology has increased rapidly, which indicates that professional engineering ship has ushered in a broad development opportunity. It plays an irreplaceable role in many kinds of underwater engineering operations, such as channel guarantee, port service, emergency rescue, water construction, underwater development, product processing, ship maintenance, dredging and dredging, and in the foreseeable future development. With the world's large number of marine development, port engineering, water conservancy engineering,
water environmental protection, bridge construction and other projects have been launched, these projects urgently need advanced technical performance, full-featured special engineering ship technology will get more space for development.

4.3 Marine Engineering Equipment Industry

Fig. 6 Distribution of Domestic Key Technologies in Marine Engineering Equipment Industry

From Figure 6, we can see that the key technologies of marine engineering equipment industry are mainly divided into three categories: offshore drilling equipment, offshore production equipment and offshore engineering development auxiliary ship and other supporting equipment. Among them, offshore engineering development auxiliary ship and other supporting patents are the most concentrated, accounting for more than 90% of patent applications, while offshore drilling equipment and offshore production equipment account for a small proportion.

5. Conclusion

In this paper, patsnap patent database is used to retrieve patent data in the field of ship and marine engineering equipment, and the number of applications from key provinces, annual changes of key provinces and distribution of key technologies are analyzed. The following conclusions and suggestions are drawn:

(1) In the field of general-purpose ships, patent applications are consistent with the economic and technological development of domestic provinces and municipalities, and often have a certain inheritance relationship with the historical development of the shipbuilding industry of various provinces and municipalities. In the field of marine engineering equipment industry, the core area of marine engineering equipment industry is in coastal and riverside areas, with strong economic strength and industrial foundation, which is the development of marine engineering equipment field in these areas. It provides favorable conditions, and the quality of authorized patents is high.

Therefore, China should maintain the inheritance of provincial and municipal shipbuilding industry, strive to break through new technology research and development and innovation; speed up patent invention and creation in Jiangsu and Guangdong provinces, cultivate high-value patents; focus on building marine industry supporting industrial clusters, vigorously promote high-end shipbuilding products, through the "business-led" to enhance the development level of ship supporting, China should extend the development of marine engineering equipment industry and vigorously develop modern ship producer services. Develop modern marine producer services and speed up breakthroughs in common key technological levels.

(2) In the field of general-purpose ships, Jiangsu Province has witnessed the most dramatic increase in patent applications, with more obvious increases in Zhejiang, Guangdong and Shandong provinces than in other provinces and municipalities, while the increase in patent applications in Liaoning and Hubei provinces is relatively flat, and the annual change is not obvious; in the field of special-purpose ships, the patent applications in Tianjin, Fujian and Liaoning provinces are more obvious. In the marine engineering equipment industry, Jiangsu Province has the most obvious
increase in patent applications than other provinces and cities, leading other provinces and cities in China.

Therefore, Jiangsu Province should maintain its growth trend, improve patent quality and actively develop and innovate high-value patents while increasing patents; other provinces and municipalities should promote cooperation between industry, University and research, speed up the construction of relevant local scientific research institutions, promote cooperation and innovation between local enterprises and scientific research institutions, and actively introduce leading foreign teams, learn and exchange experience, and promote the quantity and quality of local patents.

(3) In the field of general-purpose ships, in recent years, due to the mature technology of hull structure, active power device and auxiliary power equipment branches, the attention has been weakened, while other auxiliary machinery and equipment are the research hotspots in recent years; in the field of special-purpose ships, the trend of patent application in recent years is in the field of special-purpose ships. In the marine engineering equipment industry, the patents of marine engineering development auxiliary ships and other supporting equipment are the most concentrated, and the proportion of offshore drilling equipment and offshore production equipment is relatively small.

Therefore, our country should continue to maintain the advantages of hull structure, active power plant and other technologies, actively develop new technologies and lead the international level; accelerate the development and creation of other ship technologies, and strive to close the gap with the international advanced level; seize the opportunity to actively research and develop with the launch of a large number of marine development, port engineering, water conservancy engineering, water environmental protection, bridge construction and other projects in the world. Our country should actively develop advanced technology and full-featured special engineering ship technology.

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