ADB Project Document

TA–9036: Strategy for Liaoning North Yellow Sea Regional Cooperation and Development

Technical Report 2: Policy Opportunities for Supporting International Expansion of Liaoning Provincial Equipment Manufacturing Industry

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Abbreviations

ADB – Asian Development Bank
ASEAN – Association of Southeast Asian Nations
DOF – Department of Finance
EA – Executing Agency
GHG – greenhouse gas
IA – Implementing Agency
ICT – information and communication technology
ICTI – Internet Content, Technology, and Infrastructure
JMEPA - Japan–Mongolia Economic Partnership Agreement
LCEBDP - Liaoning Coastal Economic Belt Development Plan
LPDF – Liaoning Province Department of Finance
MDGs – Millennium Development Goals
MOC - Ministry of Commerce
MOFA - Ministry of Foreign Affairs
NDRC - National Development and Reform Commission
NEA – Northeast Asia
NSCP – North-South Corridor Plan
NSR – New Silk Road
OBOR – One Belt One Road
PFRIL - Provincial Financial Research Institute in Laioning
PRC – People's Republic of China
RCI – Regional Cooperation and Integration
SDGS – Sustainable Development Goals
SME – small and medium-sized enterprise
SOE – State Owned Enterprise
TA – Technical Assistance Plan
TIRC - Transports Internationaux Routiers Convention
WTO – World Trade Organization

Executive Summary

The equipment manufacturing industry is an industry manufacturing all kinds of technical equipment to meet the needs of the development of various sectors of the national economy, which is also so-called “machine tool” of the whole industry. The equipment manufacturing industry, which is closely related to the economic development of a country, is not only the basis of manufacturing but also the foundation of other industries. At present, the development trend of equipment manufacturing industry in the world has shown several characteristics, including globalization, agglomeration, informatization, and service-oriented, going-green, etc. Liaoning is the national heavy industrial base established in the *1st Five-Year Planning* period, known as China's *Ministry of Industrial Equipment*. Liaoning has considerable advantages in equipment manufacturing industry and plays an irreplaceable role. Improving the international level of equipment manufacturing industry is of great significance for revitalizing Liaoning province.

On the basis of defining the concept and characteristics of the equipment manufacturing industry and analysing the trend of the world's equipment manufacturing industry and its position in China's national economy, we have made a comprehensive analysis of the development status, existing problems as well as favourable and unfavourable environment of international expansion of Liaoning's equipment manufacturing industry, put forward the key tasks and policy measures of its international expansion.

As is noted in the report, during the long course of development of Liaoning’s equipment manufacturing industry, its scale had expanded continuously, as well as a large number of leading enterprises in similar industries, forming a fairly complete industrial system. Nevertheless, the development of equipment manufacturing industry in Liaoning still faces with slow growth, insufficient investment in innovation, low industrial levels, a large proportion of middle and low-end equipment products and other problems. Compared with the advanced level of the world, as for the equipment manufacturing industry, there is a great gap in the aspects of organizational structure, innovative ability, product quality and brand and there is an urgent demand for industrial transformation and upgrading. Nowadays, China is implementing *the Belt and Road Initiative* and *Made in China 2025*, building Northeast China into an important window for China's opening to the north and a hub for cooperation in Northeast Asia. Setting up China’s (Liaoning provincial) free trade experimental zone provides favourable conditions to accelerate international expansion of manufacturing industry in Liaoning Province. But it needs to be realized that the implementation of reindustrialization in developed countries brings about the increasing pressure of competition in the global market, the internationalization of Liaoning's equipment manufacturing industry becomes harder owing to the continuous acceleration of transnational operation and improvement in competitive power of other provinces.

Priorities of accelerating the international expansion of equipment manufacturing industry in Liaoning Province are as follows. First, speed up the development of priority areas including aerospace equipment, energy saving and new-energy vehicles, marine engineering equipment, high-end shipping, intelligent manufacturing equipment, UMT equipment, consolidate the foundation for international expansion. Second, upgrade further self-innovation centred around enterprises, in order to improve industrial concentration, extend the service connotation of manufacturing industry, speed up the development of high-end producer services, build a base of international equipment manufacturing industry, upgrade enterprise capacity in producing whole sets of equipment and general contracting. Third, seize the opportunity of *the Belt and Road initiative*, carry out extensive exploration of the middle-end international market, further enhance the ability of enterprises to guard against risks in transnational operations, optimize the product structure, speed up the implementation of *going global*. Fourth, construct overseas industrial parks, undertake foreign equipment manufacturing projects, acquire overseas enterprises, promote international capacity cooperation and resolve excess production capacity. Fifth, expand both upstream and downstream of the global value chain, enhance downstream channels and brand capabilities and upstream innovation capabilities, reverse the disadvantage of being locked down at the low end, and then improve profitability in the global value chain.

To undertake priorities of accelerating the international expansion of equipment manufacturing industry in Liaoning Province, further promote the development of equipment manufacturing industry in Liaoning Province, we need to push forward continuously the liberalization of concept, deepen the reform and opening, continuously reduce the dominant influence of state owned large equipment manufacturing enterprises, encourage private capital to enter into the area of general equipment manufacturing. We also need to enhance organization and leadership, seize the opportunity of jointly building the Belt and Road, organize a leading group of development of internationalization, promote the international expansion of equipment manufacturing industry comprehensively. Information platform is needed to provide the source of projects and resources of information. Public finance and taxation should be further strengthened and special funds to be created. The government needs to expand the financing channels and implement the financial support policies. Talent is crucial, it’s necessary to create a team of transnational management interdisciplinary talents with the ability of development of international market, as well as a good understanding of rules of international economic operation as well as local laws and regulations.

I. Introduction

1. The equipment manufacturing industry is a pillar of China's economic and social development. Highly developed equipment manufacturing industry is a fundamental condition to realize new industrialization and a significant indication that shows the comprehensive national strength and technical level. The CCP Central Committee and the State Council attach great importance to the development of the equipment manufacturing industry, especially its of international expansion.

2. Liaoning is the national heavy industrial base established in the "1st Five-Year Plan" period, known as China's "Ministry of Industrial Equipment". In the equipment manufacturing industry, it has considerable advantages and plays an irreplaceable role. Speeding up the development of equipment manufacturing industry from the middle-and-low end to the middle-and-high end and improving its international level is of great significance for promoting Liaoning's industrial transformation and upgrading and building a strong province in manufacturing. The *13th Five-Year Plan for Liaoning's Equipment Manufacturing Industry Development* puts forward: "To build Liaoning a national strategic base and core cluster area of high-end equipment and intelligent equipment manufacturing industry, we should focus on the field of high-end equipment, make efforts to improve the industrial chain system, enhance the core competitiveness of equipment manufacturing industry and promote the development of equipment manufacturing industry from the middle-and-low end to the middle-and-high end from the strategic view of creating a 'Seal of the State'[1]

3. On the basis of the concept and characteristics of the equipment manufacturing industry and analyzing the trend of the world's equipment manufacturing industry and its position in China's national economy, we make a comprehensive analysis of the development status, existing problems as well as favorable and unfavorable environment of international expansion of Liaoning's equipment manufacturing industry, and put forward the key tasks and policy measures of its international expansion, which will provide a useful reference to achieve this objective.

[1] Note: Chinese idiom, it was first appeared in records of Grand Historian (Shi Ji) in China's Han dynasty. It is used in this Introduction to be a metaphor showing the importance of the equipment manufacturing industry. China had a recording movie with this title showing the achievements of China's equipment manufacturing industry.

II. Overview of Equipment Manufacturing Industry

A. Concept and characteristics of equipment manufacturing industry

1. Concept

4. At present, there is no uniform definition and scope of the equipment manufacturing industry. In Japan, it is defined as an industry of machinery production, including factory automation equipment and industrial machinery manufacturing industry. According to the current statistical indicator system in China, the equipment manufacturing industry is divided into the following 8 categories: metal product industry, general equipment manufacturing industry, special equipment manufacturing industry, transportation equipment manufacturing industry, weapons and ammunition manufacturing industry[2], manufacture of electrical machinery and apparatus, computer, communications and other electronic equipment manufacturing industry, manufacture of measuring instruments and machinery and culture & office machinery manufacturing industry. The equipment manufacturing industry is an industry manufacturing all kinds of technical equipment to meet the needs of the development of various sectors of the national economy.

2. Characteristics

5. The equipment manufacturing industry is characterized by a wide range, multiple categories, high technical content, and high linkage with other industries. The equipment manufacturing industry, closely related to the economic development of a country, is called "machine tool" of the whole industry – it is not only the basis of manufacturing but also the foundation of other industries. It is the essential means and industry carrier for transforming high-tech into the real productive forces. With the trend of being high technology-based, integrated and intelligent, it represents the direction of the development of advanced productive forces in a qualified sense.

6. The development level of equipment manufacturing industry reflects the comprehensive supporting capacity of a country in the aspects of science and technology, process design, materials, processing and manufacturing, etc. In particular, the significant technical equipment manufacturing capacity with high technical challenge, completeness and cross-industry supporting reflects the economic and technological strength of a country. Therefore, according to the

[2] Due to data limitations, the weapons and ammunition manufacturing industry is not discussed in this report.

international statistics, some modern machinery and equipment manufacturing industries have been included in the high-tech industries.

7. The equipment manufacturing industry is strong in linkage and industrial promoting. It involves not only the machinery processing industry, but also materials, electronics and machinery spare parts processing and other supporting industries. Its development can drive and support the development of a large number of related industries.

8. The equipment manufacturing industry provides all industries with modern equipment. It is indispensable to all sectors, from the mechanization of agricultural production to the weapons and equipment for national defense. Therefore, its development is conducive to improving the technical level and productivity of all sectors of the national economy, thereby enhancing the national competitiveness. Many industrialized countries, in their mature stage of industrialization, take the equipment manufacturing industry as a leading industry.

B. Development trend of equipment manufacturing industry in the World

9. In recent years, the development trend of manufacturing industry in the World has been eye-catching, and its characteristics are more prominent in the equipment manufacturing industry. These trends in equipment manufacturing industry also represent the obvious characteristics of the manufacturing industry.

1. Globalization

10. Because of the modern technology revolution, especially the development of the information technology revolution, great changes have taken place in the world's manufacturing industry, which leads to the globalization trend of manufacturing industry continuously strengthening. The globalization strategy is the preferred strategy to guide multinational manufacturing enterprises to seize the world market.

11. Since the 1980-90s, because of the revolution in information technology, the management thought and methods have undergone fundamental changes, so does the form of enterprise organization. These changes have been developed and played very well in multinational enterprises, especially those in the equipment manufacturing industry, and will continue to develop as a new type of globalization. The main feature of these changes is the extensive use of production facilities and technical force in other countries, which can make the

final products and sell them globally, without owning the ownership of the production facilities and manufacturing technology.

2. Agglomeration

12. Since the 1990s, the clustering trend of the global equipment manufacturing industry is developing continuously – a place (region) is clustered organically with manufacturing enterprises of the same or related industries, which gain a competitive advantage through continuous innovation. In the process of industry clustering, SMEs with characteristics play an important role. Geographically concentrated enterprises and related institutions (universities, chambers of commerce, etc.) compete and cooperate in specific fields.

3. Information-based

13. The integration of the new-generation information and communication technology with the manufacturing industry is the main line of the new round of the revolution of science and technology and industrial change. Manufacturing industry development strategies of developed countries such as the Industry 4.0 of Germany, the Industrial Internet in the United States and the New Industrial France all take intelligent manufacturing as an important direction of development and change. Intelligent manufacturing includes intelligent products, equipment, production, management and service. The main carriers are intelligent factories and workshops. Cyber-physical system (CPS) is an important means to realize the intelligent manufacturing. This system achieves the real-time perception and dynamic control of large physical systems and information interaction systems by the integration of data, communication and control, so as to realize the true integration of person, machine and materials, which achieves accurate management of production process through comprehensive interaction and real-time feedback and greatly improves the production efficiency. The system can be used to achieve the goal that the traditional manufacturing cannot achieve. Its typical approach is the production of customized production to maximize the individual needs. Its main approach is embedding multiple production modules in each manufacturing process to realize that every process from the very beginning is matched seamlessly with the production module to the production requirements of each product through the digital management. And the batch customization is realized without interruption in the production process.

4. Service-oriented

14. Nowadays, the consideration of manufacturing industry, including the whole process from market research, product development or improvement,

manufacturing, sales, after-sales service to the product scrap, disintegration or recovery, involves the entire life cycle of products and reflects the spirit of serving customers and the society in all aspects. With the coming and development of knowledge economy, the manufacturing industry is being transformed into service industry and information industry in a certain sense. In recent years, the development of networked manufacturing and e-commerce has fully demonstrated the trend of service-oriented equipment manufacturing industry. "Fast delivery", exceeding quality and price, has become the first factor to determine the success or failure of an enterprise. This also shows the trend of service-orientation in the manufacturing industry. With the development of the trend of service-oriented equipment manufacturing industry, the proportion of service sales (refers to global service, the same below) in many enterprises in continues to improve, and the contribution of service to gross margin and operating margin increases increasingly.

5. Going green

15. From the perspective of green development, two aspects need to clarify. On one hand, new energy technologies, such as solar photovoltaic and shale gas, are improving; the clean energy applications are maturing; emissions of carbon and sulfur compounds and other greenhouse gas and pollutant decrease gradually; and the manufacturing industry further develops in the direction of low energy consumption and low pollution. On the other hand, new product design and production concepts, such as "green supply chain" and "low-carbon revolution" in Europe and the United States and "zero emission" in Japan, continue to rise; the energy saving and environmental protection industry, remanufacturing industry and other industrial chains are improving; and the "green manufacturing" and "additive manufacturing" are becoming widely applied, which further enriches the connotation and mode of the green development of manufacturing industry.

C. Position and function of the equipment manufacturing industry in China's national economy

16. The manufacturing industry is the foundation and backbone of a country. The equipment manufacturing industry is the core and backbone of manufacturing industry, an important symbol of industrial development and the basic and strategic industry providing the national economy and national defense construction with technology and equipment.

1. The largest industrial sector

17. China is the only country in the world that owns all the industrial categories in the UN's Industrial Classification. The complete industrial system is the advantage and guarantee for the sustainable development of China's equipment manufacturing industry. In 2014, China's output of more than 220 kinds of industrial products and the net export of manufacturing industry ranked first in the world, and the added value of manufacturing industry accounted for 20.8% of the whole world. In 2014, the output of equipment manufacturing industry exceeded 22 trillion CNY, accounting for more than 1/3 of the whole world, and ranking No.1 in the world for five consecutive years. Most of China's equipment production ranks first in the world. In 2014, its power generation equipment output was 150 million kilowatts, accounting for about 60% of the global total; its shipbuilding completion was 39.5 million deadweight tons, accounting for 41.7% of the global total; its automobile output is 23.723 million, accounting for 26.3% of the global total.

2. High employment capacity, energy (resource)-saving and high value-added

18. The equipment manufacturing industry is technology and capital intensive, but different from the process industry, it is of assembly type, which has the characteristics of being labor-intensive and can provide a large number of employment opportunities. As for the equipment manufacturing industry, the fixed assets at original price of 10,000 CNY can create jobs for 0.078 person, while that of the industrial average is 0.052 person - chemical raw materials and chemical products industry: 0.046 person, metallurgical industry: 0.037 person, petroleum processing and coking industry: 0.018 person. The equipment manufacturing industry does not only attract a large number of labor forces, but also has a high degree of correlation in upstream and downstream. The investment in the equipment manufacturing industry can also promote the development of other industries and increase the employment of related industries. To solve the employment issues and alleviate the pressure of employment is of vital importance to maintaining social stability and solidarity.

19. Equipment manufacturing industry is a technology-intensive industry with high technology and high added value. With the equipment manufacturing industry continuing to adopt high technology and application of information technology, software technology and advanced manufacturing technology in equipment manufacturing industry, technical equipment is becoming more and more software-based, and there will be more advanced equipment manufacturing industry entering into the high technology industry category.

3. Strategic industry concerning comprehensive national strength

20. The competitiveness of a country as a whole depends largely on the competitiveness of the manufacturing industry. The equipment manufacturing industry plays not only a significant supporting role in the manufacturing industry, but also a connecting role in the national economy.

21. Firstly, the equipment manufacturing industry, the important support and guarantee to industrial structure adjustment and upgrading, is an important part of industrial restructuring and transformation as well as structural optimization and upgrading, while providing a large number of advanced equipment for various industrial sectors.

22. Secondly, the equipment manufacturing industry does not only contribute to the optimization of the production factors and industrial, technical and product structure, and the level of quality and technical equipment of various industrial sectors, but also can greatly improve the production efficiency, save energy and resources, protect the ecological environment, improve the quality of economic operation and promote the sustainable development of economy.

23. Thirdly, the equipment manufacturing industry is not only the foundation of high-tech production and industrialization, but also the medium and bridge of high-tech transformation into productivity. Whether it is the development and industrialization of computer, communications equipment and aerospace equipment, or marine engineering and biological pharmaceuticals, the equipment manufacturing industry is needed to provide them with advanced production equipment and measuring and control equipment.

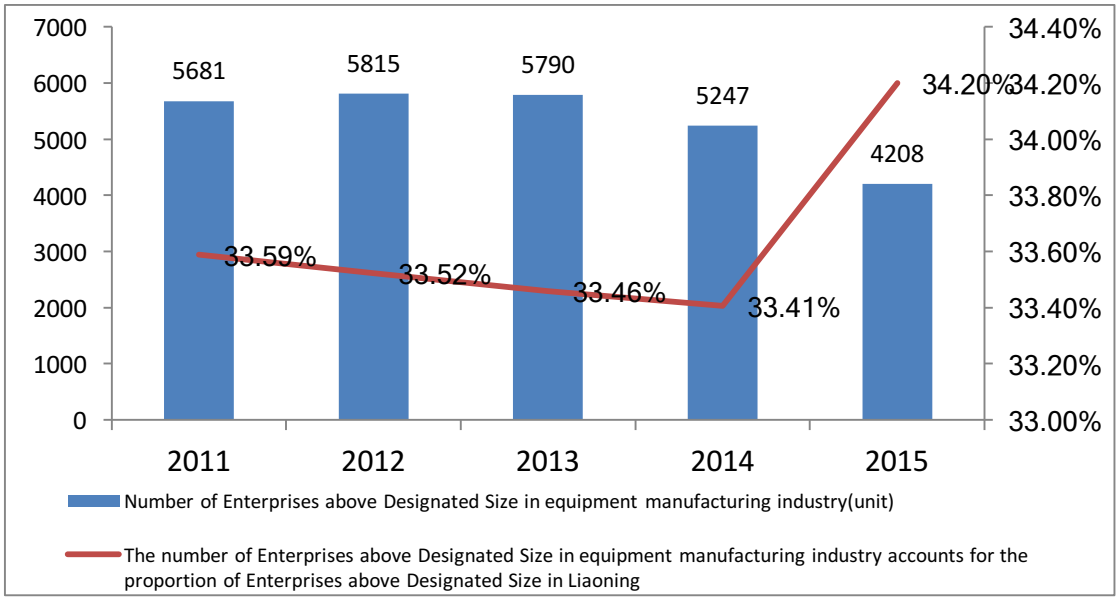
III. Development Status of Liaoning's Equipment Manufacturing Industry

A. Overall development of Liaoning's equipment manufacturing industry

24. Liaoning equipment manufacturing industry has a long history. In the long course of development, it has formed an industrial base with complete categories and some categories with comparative and competitive advantages.

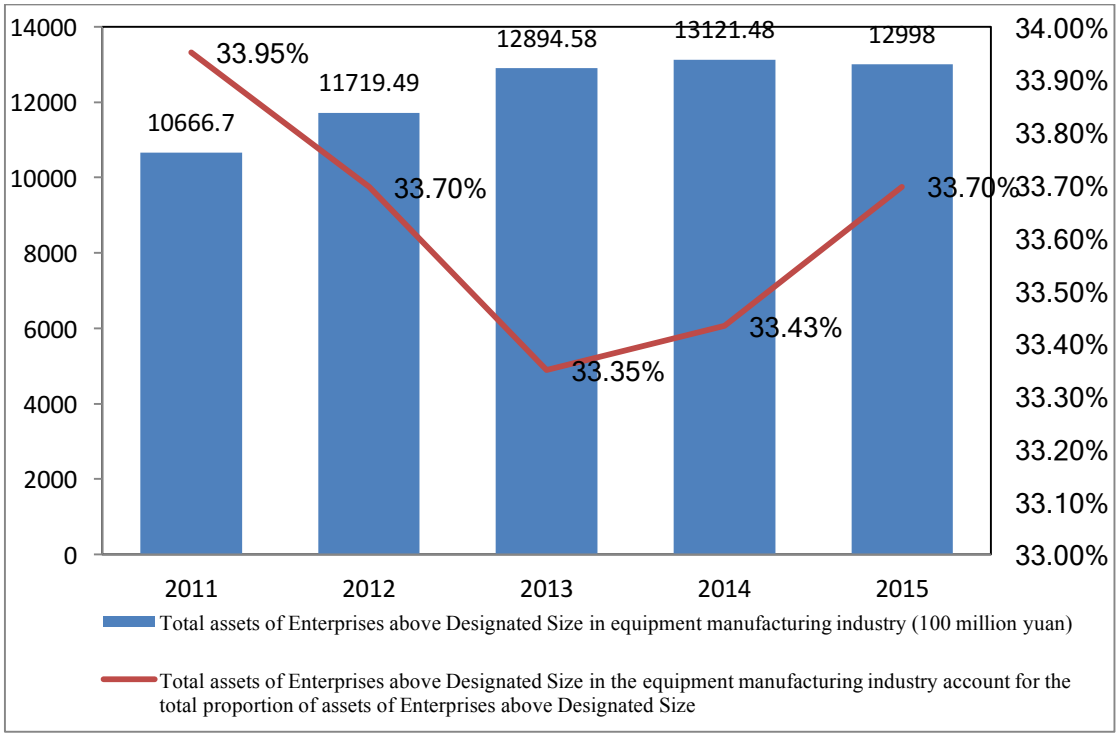
1. The scale of the industry is growing steadily

25. In recent years, equipment manufacturing industry as the most prominent pillar industry in Liaoning's industry has further strengthened its status. In 2015, in Liaoning Province, there are 4208 enterprises above-designated size in equipment manufacturing industry, accounting for 34.2% of the total of industrial enterprises above-designated size; their assets are 12,998 CNY, accounting 33.7% of the total of industrial enterprises above-designated size; their prime operating revenue is 10,809 CNY, accounting for 32.52% of the total of industrial enterprises above-designated size. The industrial added value of equipment manufacturing accounts for 32.3% of the Province's whole industry, ranking first in all sectors, 0.8 percentage points higher than that in 2010. The enterprises above designated size in equipment manufacturing industry have realized profits of 53 billion CNY, accounting for 49.54% of the Province's whole industry, 13 percentage points higher than that in 2011.



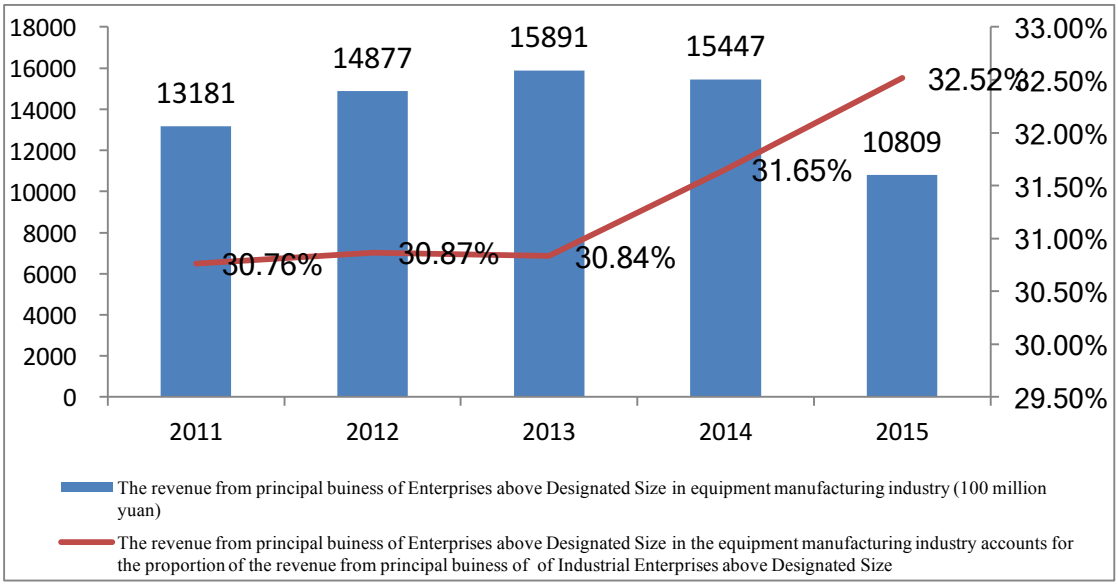
Data sources: Liaoning statistical yearbook (2016).

Figure 1 Number of enterprises above designated size in equipment manufacturing industry in Liaoning Province



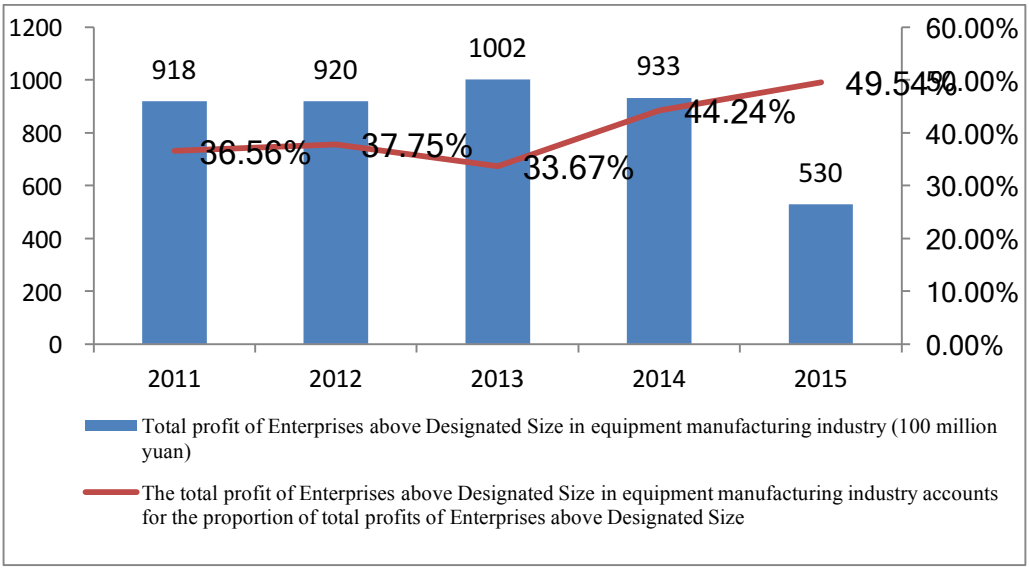
Data sources: Liaoning statistical yearbook (2016).

Figure 2 Assets of enterprises above designated size in equipment manufacturing industry in Liaoning Province



Data sources: Liaoning statistical yearbook (2016).

Figure 3 Prime operating revenue of enterprises above designated size in equipment manufacturing industry in Liaoning Province



Data sources: Liaoning statistical yearbook (2016).

Figure 4 Total profit of enterprises above designated size in equipment manufacturing industry in Liaoning Province

2. There are a large number of leading enterprises in the industry

26. Liaoning's equipment manufacturing industry has a large number of leading enterprises in similar industries in China, which are mainly located in Shenyang and Dalian and thus form a competitive industrial cluster. Shenyang Aircraft Corporation (SAC) is the research and production base of China's military

fighters. Since its foundation, many types of China's military fighters are developed in SAC, which supports the construction of China's modern national defense. CRRC Shenyang Co., Ltd., as the leading enterprise of domestic railway rolling stock industry, is mainly engaged in goods wagons manufacturing as well as overhaul diesel rolling stocks inspection and maintenance. The goods wagons produced there are the most in Asia. Shenyang Machine Tool (Group) Limited, with 1 state-level technical center and 3 industry research institutes, is mainly engaged in the developing and manufacturing of machine tools. It is one of the national priority high-tech development enterprises. Shenyang Blower Works Group Corporation (SBW) has been a leading enterprise in the blower industry. Its products are sold well in China and the market share is over 50%. The National Blower Research Institute and Fan Quality Supervision and Inspection Center are in SBW. The performance indicators of compressors developed and manufactured by SBW using imported foreign technology are far ahead of the world. Shenyang Transformer Research Institute is a state-level transformer testing center. Dalian Heavy Industry Group Co., Ltd., restructured with the merger of 2 large groups having great influence, is one of the 520 key enterprises in China. After several years of development, Dalian Heavy Industry Group has occupied a leading position in China. It is the most competitive enterprise in China's heavy machinery industry, with the highest operating efficiency and the largest operating scale.

3. The industrial structure is constantly optimized

27. In recent years, with a good equipment manufacturing base, Liaoning has been focusing on the development of a number of high-end equipment products, the proportion of high-end equipment manufacturing accounting for the equipment manufacturing industry increases from 10% in 2010 to 16.2% in 2015, and the industrial structure has been further optimized and upgraded. The aerospace equipment industry has made progress in the field of civil aircraft development, general purpose whole aircraft manufacturing, subcontract production of aero-engine parts, aviation parts production, gas turbine development, aerospace technology application and other fields, and the industrial chain has been extended. The new energy automotive industry, covering battery electric vehicles, plug-in hybrid electric vehicles and other whole vehicle series as well as batteries, motors, electronic control systems and other core components; The marine engineering equipment products cover a wide range, including jack-up drilling platform, semi-submersible drilling platform, floating production storage and offloading (FPSO), marine engineering ship and other major products, and industrial technology level has been further improved; The intelligent equipment industry, showing a good development momentum in the aspects of high-end CNC machine tools, flexible manufacturing systems, automation

equipment, industrial robots, intelligent instruments and systems and smart grid equipment, ranks among the best in China.

4. Innovation capability continues to strengthen

28. The independent innovation system of equipment manufacturing industry taking enterprises as the main players, aiming at the market and combining industry, university and research institution has been further improved. By 2015, among the equipment manufacturing industry of Liaoning Province, there are 22 state-level and 294 provincial-level enterprise technical centers, with an increase of 155 compared with 2010. The successful development of large number of new products at international advanced level has broken the long-term technical monopoly of foreign enterprises. A lot of new products, such as the 20MW electric-drive long-distance natural gas pipeline compressor unit of SBW, ZZDFPZ-250000/500-800 converter transformer of TBEA Shenyang Transformer Group, 1725mm hot rolled/1650mm cold rolled high performance magnesium alloy plate rolling equipment of Northern Heavy Industries Group and engine cylinder block and head flexible processing automatic production line of Dalian Machine Tool Group Corporation have filled the blankness in China and reached the international advanced level. By 2015, a total of 60 sets of major technical equipment projects in the Province have obtained provincial financial support and effectively promote the industry's innovation and development. 70 national major science and technology projects of high-end CNC machine tools and basic equipment undertaken in the Province have led the industry's development.

5. Agglomeration effect emerges increasingly

29. Liaoning Province, a transportation junction and core area of economic development in Northeast China will become an important growth pole of the new round of national economic development with the strong support of the State. Liaoning has unique geographical features and advantages of natural environment. It is close to South Korea and Japan; and its coastal port cities are also gradually established; the basic and investment environment of core cities have been further improved; the Province's economic and environmental policies and public service environment continue to improve; the development strategy of “Liaoning Coast Economic Belt” gives Liaoning's equipment manufacturing industry new advantages. The development of a number of industrial bases has led to the improvement of industrial concentration of Liaoning's equipment manufacturing industry. Tiexi District of Shenyang becomes the first development demonstration zone of equipment manufacturing industry in China, Panjin's petroleum equipment industry and Chaoyang's new

energy industry electrical appliance industry as the characteristic industry bases are included in the China Torch Plan, and Dalian Jinzhou District is listed as one of the national intelligent equipment manufacturing industry demonstration bases in China. The industry clusters of bearing in Wafangdian and auto parts in Dadong, Shenyang are included in the Province's key industrial clusters. In 2015, the equipment manufacturing industry cluster has achieved a total sales revenue of 1088.5 billion CNY, with an average growth rate of 12.6%. The development and expansion of a number of pacesetter enterprises have led to the rapid development and overall upgrading of the industry. In 2015, there are 11 enterprises with a prime operating revenue of more than 10 billion CNY, including Brilliance Auto Group, SAC, DSIC, Shenyang Machine Tool Group, Dalian Machine Tool Group, Northern Heavy Industries Group and CRRC Dalian Company, and that of Brilliance Auto Group is more than 150 billion CNY.

6. There is a decline in growth of economic efficiency indicators of key industries

30. In 2016, the industrial value added of enterprises above designated size in Liaoning's equipment manufacturing industry falls by 11.7%, the prime operating revenue is 745.73 billion CNY, with a year-on-year decrease of 26.3%; in 2016, the industrial profit of enterprises above designated size in Liaoning is 31.92 billion CNY, with a year-on-year decrease of 35.2%; the profits and taxes are 59.72 billion CNY, with a year-on-year decrease of 27.7%. In 2016, the prime operating revenue of Liaoning's metal cutting machine tool industry is 33.33 billion CNY, with a year-on-year decrease of 17.7%, and the industry loss is 1.15 billion CNY. The output of metal cutting tools is 92,492 units, with a year-on-year decrease of 3%, of which the output of CNC machine tools is 6,8197 units, with a year-on-year increase of 10.5, and the product CNC rate is 73.7%, 10.5 percentage points higher than the same period last year. The industrial added value of automobile manufacturing industry declines slightly and the passenger car production increases significantly. Throughout the year, the industrial added value of automobile manufacturing industry drops by 0.2% year on year. The automobile output is 1.132 million units, dropped by 3% year on year, of which the passenger car production is 675 thousand units, increased by 11.2% year on year. The sales revenue of the automotive industry is 270.67 billion CNY, dropped by 0.8% compared with the same period last year, with a total profit of 19.16 billion CNY, dropped by 20.2% compared with the same period last year. The production of shipbuilding industry is stable and the industry continues to suffer losses. In 2016, the shipbuilding completion is 5.373 million tons, with a year-on-year increase of 15.2%, maintaining a positive growth for 7 consecutive months; the holding order is 13.63 million deadweight tons, dropped by 7.1% compared with the same period last year. The prime operating revenue of the

Province's 8 key enterprises is 46.56 billion CNY, dropped by 11.2% compared with the same period last year, with a loss of 2.2 billion CNY.

B. Internationalization of Liaoning's equipment manufacturing industry

1. Export of equipment manufacturing industry

31. The equipment manufacturing industry is not only an important support and source of Liaoning's economic growth, fiscal revenue and employment opportunities, but also the main force in creating exports. In 2014, the export value of Liaoning's equipment manufacturing products amounted to 11.8 billion US dollars, accounting for 20% of the Province's total exports. In recent years, the export delivery value of Liaoning's equipment manufacturing industry is relatively stable and accounts for 40%-50% of the total export delivery value of all industrial enterprises above designated size. However, what can't be ignored is that the growth rate of the export delivery value of equipment manufacturing industry in Liaoning has shown a downward trend. In 2015 and 2014, the export delivery value of Liaoning's equipment manufacturing industry dropped by 3.7% and 4.2% year on year respectively.

32. In the process of Liaoning's equipment manufacturing industry participating in the international market, the situation of each subdivision industry is quite different. In recent years, the transportation equipment manufacturing industry, large in foreign trade scale and high in growth rate, accounts for a large proportion of the export delivery value of the equipment manufacturing industry, followed by communication equipment, computer and other electronic equipment manufacturing industry.

Table 1 Export delivery value of all sectors of equipment manufacturing industry in Liaoning (2015)

Sectors	Sales value（100 million yuan）	Export（100 million yuan）	Proportion of export delivered to Sales value
Electrical, mechanical and equipment manufacturing industry	1301.50	111.06	8.53%
Transportation equipment manufacturing industry	1012.43	255.00	25.19%
Metal products manufacturing industry	1132.26	65.64	5.80%
Computer, communications and other electronic equipment manufacturing industry	573.34	218.74	38.15%
General equipment manufacturing industry	2302.20	157.38	6.84%
Instrumentation and culture, office machinery manufacturing industry	160.21	21.87	13.65%
Special equipment manufacturing industry	1514.03	87.76	5.80%

Data sources: China Industrial Statistics Yearbook(2016).

2. Foreign trade structure of equipment manufacturing industry

33. The foreign trade structure of Liaoning's equipment manufacturing industry includes commodity structure, regional structure, trade mode structure, trade participant structure and so on. In different periods, the foreign trade structure presents different characteristics. Take 2014 as an example. In terms of exports structure of equipment manufacturing industry, ship products takes a large part according to the statistics of Shenyang Customs. The ship exports is 5.15 billion USD, with a year-on-year increase of 21.4%, accounting for 36% of the entire equipment manufacturing industry exports. In terms of the regional structure of exports, it mainly exports to Hong Kong, Japan, ASEAN, EU and the United States, which accounts for 66% of the total exports of Liaoning's equipment manufacturing products in 2014. In terms of the trade mode structure, the export of equipment manufacturing industry products in Liaoning by way of processing trade is 9.28 billion USD, with a year-on-year increase of 21.7%, accounting for 64.8% of the total, and that by way of general trade is 3.81 billion USD, with a year-on-year increase of 26.8%. In terms of the exporter structure of equipment manufacturing industry, the exports of foreign-invested enterprises is 7.03 billion USD, with a year-on-year increase of 18.3%, accounting for 49.1% of the total, that of state-owned enterprises is 4.96 billion USD, with a year-on-year increase of 31.3%, and that of private enterprises is 2.07 billion USD, with a year-on-year increase of 25.6%.

3. Overseas investment of Liaoning's equipment manufacturing industry

34. By the end of 2015, the overseas direct investment of Liaoning's equipment manufacturing industry amounts to 4.3 billion USD, accounting for 21.7% of the provincial total; there are a total of 451 approved and registered projects, accounting for 22.3% of the provincial total. In the first half of 2016, the overseas investment of equipment manufacturing industry reaches 0.93 billion USD, accounting for 38.3% of the provincial total; there are a total of 26 approved and registered projects, accounting for 23.6% of the provincial total. The investment concentrates in the mining, manufacturing and metallurgical industries, mainly in ASEAN, Central Asia, Europe and North America as well as Africa.

4. Enterprises' participation in international competition

35. During the "12th Five-Year Plan" period, Liaoning has made full use of "both the domestic and international markets and resources" and accelerated the implementation of "going global" strategy in its equipment manufacturing

industry, some strength-based enterprises are active in the international market competition. For example, TBEA Shenyang Transformer Group has made full use of international and domestic markets in recent years to actively carry out international strategy while working on China's electric power construction. Currently, it has 27 overseas offices in the world, and its products are sold to more than 30 countries and regions. It has launched factory construction in India, completed the high-end products export to the United States, Canada and Russia, and achieved a huge leap forward from "providing equipment to China" to "providing equipment to the World". At present, some equipment manufacturing enterprises in various areas in Liaoning have been accepted by the international market. With improving reputation, these enterprises already have a strong strength and favorable conditions to "going global".

5. Foreign investment projects

36. Northern Heavy Industries Group acquired the Robbins Company at the price of 156 million USD to develop tunneling equipment and ancillary equipment project. Upon its completion, it is expected to drive exports of 2 billion USD within 10 years. Based on the overseas development model of "product + service + technology + investment", CRRC Dalian Company got an order of 232 diesel rolling stocks in South Africa with a total amount of 904 million USD, creating the record of China's highest value in single order of diesel rolling stocks. Shenyang Yuanda Group and Stone India, India's largest rail transportation manufacturing company, entered into a joint venture agreement, planning to invest 200 million CNY for the establishment of India's largest elevator manufacturing enterprise. Shenyang Lianli Copper Company and Ordabasy Group of Kazakhstan entered into a cooperation framework agreement, planning to invest a total investment of 800 million USD for the copper resources comprehensive development and smelting project. Anshan Haicheng Petroleum Machinery Group and the government of Republic of Bashkortostan entered into a cooperation agreement, planning to invest a total investment of a total of 300 million USD for the construction of petroleum equipment manufacturing industrial park. At present, the planning of 2 sq. km zone (Phase 1) has completed. Brilliance Automobile Group has set up a whole vehicle production base in Egypt. The key overseas investment projects of these manufacturing enterprises have explored new ways, accumulated new experiences and provided typical demonstrations for manufacturing enterprises in Liaoning Province foreign in overseas investment and participation in international development and broadened the space of international cooperation in capacity and equipment manufacturing.

C. Problems in the Development of Liaoning's Equipment Manufacturing Industry

37. The development of equipment manufacturing industry in Liaoning faces with slow growth, insufficient investment in innovation, low industry levels, a large proportion of middle and low-end equipment products and other problems. Compared with the advanced level of the world, as for the equipment manufacturing industry, there is a great gap in the aspects of organizational structure, innovation ability, product quality and brand and there is an urgent demand for industrial transformation and upgrading. The related infrastructure and service system construction for the equipment manufacturing industry development are to be strengthened and improved.

1. Relatively low efficiency and effectiveness

38. Although Liaoning equipment manufacturing industry occupies a dominant position in China and has unique geographical advantages and adequate human and material resources, judging from efficiency and effectiveness, the gap between Liaoning and other provinces and municipalities remains relatively large, and there are still many areas that need to be further improved. By the end of 2014, there are 4,823 enterprises above designated size in equipment manufacturing industry in Liaoning, and the major economic indicators are as follows: the total industrial output value, sales income and total profits are respectively 1248.36 billion CNY, 358.268 billion CNY and 62.503 billion CNY, and the average enterprise industrial value added, sales income and total profits are respectively 263 million CNY, 74 million CNY and 4.93 million CNY. While in the same period, there are 19,113 enterprises above designated size in equipment manufacturing industry in Jiangsu, the total industrial output value, sales income and total profits are respectively 6,008.954 billion CNY, 5,937.853 billion CNY and 383.815 billion CNY, and the average enterprise industrial added value, sales income and total profits are respectively 314million CNY, 311 million CNY and 6.46 million CNY, which is respectively 1.19 times, 4.2 times and 1.31 times of that of Liaoning. Judging from the main statistical indicators, Liaoning accounts for a considerable proportion in China (see Table 2), especially in the two major industries of special equipment manufacturing and general equipment manufacturing. The industry sales value, prime operating revenue and total profit of Liaoning's general equipment manufacturing ranks No.3 in the whole country; as for its special equipment manufacturing industry, the total product assets ranks the fourth, the industry sales value and total profit rank the fifth. As for the computer, communications and other electronic equipment manufacturing industry, the overall scale and efficiency are inferior, with the industry sales value, prime operating revenue and total profit ranking the fifteenth in China.

Table 2 Indicators and rankings of Liaoning's equipment manufacturing industry Unit: 100 million CNY

Index		Metal products manufacturing industry	General equipment manufacturing industry	Special equipment manufacturing industry	Transportation equipment manufacturing industry	Electrical, mechanical and equipment manufacturing industry	Computer, communications and other electronic equipment manufacturing industry	Instrumentation and culture, office machinery manufacturing industry
Sales Value of Industry（100 million yuan）	Liaoning	1899.25	3968.53	2238.24	1080.75	2101.92	889.77	224,03
	China	36612.45	47159.91	35039.02	18655.82	66921.57	85274.75	8286,27
	Ranking	6	4	5	6	9	17	9
Export Value（100 million yuan）	Liaoning	79.97	209.01	265.54	260.05	126,99	259.5	17,9
	China	3836.85	5173.75	3228.73	3511。07	9885.05	46165.14	1240.52
	Ranking	9	6	5	6	10	16	7
Total Assets（100 million yuan）	Liaoning	1106.7	2756.72	2208.96	2210.82	1372.52	829.76	208.54
	China	26013.06	39798.84	33724.19	21112.58	52333.16	59973.73	7309.82
	Ranking	6	5	5	2	9	15	9
Revenue from Principal Business（ 100 million yuan）	Liaoning	1894.04	3332.34	2193.76	1080.17	2127.93	915.55	222.27
	China	36396.44	39522.45	34826.39	18158.64	66977.77	85486.3	8347.58
	Ranking	6	4	5	5	9	17	9
Selling Expenses（100 million yuan）	Liaoning	35.93	103.75	48.15	11.02	49.77	19.59	7.16
	China	726.2	1329.17	1024.32	317.38	2355.86	1862.26	306.32
	Ranking	8	5	8	11	10	14	10
Total Profits（100 million yuan）	Liaoning	82.63	215.19	95.71	52.62	91.44	66.1	21.54
	China	2160.8	3149.34	2261.53	1079.27	4162.98	4282.57	720.76
	Ranking	8	5	8	7	10	15	8
Number of Unprofitable Enterprises(unit)	Liaoning	4.6	20.87	10.53	6.23	7.26	3.51	1.54
	China	87.77	173.16	219.92	115.09	316.5	315.81	21.51
	Ranking	7	2	8	7	9	14	5
Annual Average Employees(10000 persons)	Liaoning	16.97	38.65	17.64	11.29	16	8.15	2.64
	China	380.12	489.62	355.02	193.32	637.82	906.59	106.93
	Ranking	7	5	6	7	11	19	11

Data sources: China Industrial Statistics Yearbook (2016).

2. The system of specialized labor division and cooperation is unsound, and the system integration capability is relatively low

39. The industrial ecology of equipment manufacturing in Liaoning is unsound; the upstream and downstream of the industrial chain has not yet been got through completely, leading that the role of enterprises and market allocation of resources can't be brought into play better. The equipment manufacturing industry faces the problems of uneven development in the industrial chain and lack of resource sharing, which restricts the industry from upgrading to the high-end. The current situation of major subdivision industry chains is that there are some leading enterprises, many of which are of tens of billions CNY and some even have world-class brand and discourse rights. However, the small and

medium-sized enterprises are at the bottom of the industry chain, with relatively small scale, weak technology and poor equipment and lack of self-upgrading capability, and it is difficult to support the breakthroughs of the industry evolving to the high-end. Thus, the local basic materials, parts and components industry is undeveloped, and a large number of key materials and basic components need to be outsourced or imported. At the same time, it is difficult for specialized service enterprises to get in the supply chain of manufacturing enterprises, and can't form the pattern of integrative development of producer services and equipment manufacturing.

3. Crucial techniques and high-end equipment are highly dependent on foreign countries

40. The equipment manufacturing industry has problems such as high dependence on foreign products and techniques, inadequate development of high-end equipment manufacturing and low value added of products. The comparative advantage of equipment manufacturing industry value chain is mainly in the final assembly link, and on the whole, it is in the stage of equipment processing base rather than equipment manufacturing base. Some techniques of the equipment manufacturing industry are world-leading, but the complete equipment is at the middle and low-end level. There is a lack of joint research and development and results sharing in materials, machinery, electrical, hydraulic and other basic and generic technology of equipment manufacturing due to the division of labor for a long time. Foreign countries control key components – most supporting key components of high added value are purchased from European and American enterprises, becoming a bottleneck for industry evolving to the high-end. The lack of core components, materials and manufacturing processes, system design, etc. eventually results in inadequateness of product performance and reliability.

4. The state-owned economy is high in proportion, and the system and mechanism are not flexible

41. In the process of the development of Liaoning's equipment manufacturing industry, a lot of large and small state-owned equipment manufacturing enterprises have been established. In the early stage of its development, the state-owned enterprises did play a leading role, e.g. SAC, Shenyang Machine Tool Group and other large ones, and had made great contributions to China's socialist construction. However, with the deepening of China's socialist market economic system reform, it shows a great incompatibility between the traditional state-owned enterprises and the market economy; therefore, the upsurge of state-owned enterprise reform has been raised all over the country. In this

regard, the reform of state-owned enterprises in Liaoning's equipment manufacturing industry is relatively slow.

42. In 2015, the state-owned capital accounts for 34.5% of the paid-in capital of Liaoning equipment manufacturing industry, while Hong Kong, Macao and Taiwan capital and foreign capital together account for 14.5%. The state-owned capital accounts for 8.6% of the paid-in capital of national equipment manufacturing industry, while Hong Kong, Macao and Taiwan capital and foreign capital together account for 26.9%. The state-owned capital accounts for less than 5% of the paid-in capital of equipment manufacturing industry in Guangdong, Jiangsu, Zhejiang and other south-east coastal provinces, while Hong Kong, Macao and Taiwan capital and foreign capital together account for more than 40%. Thus, the state-owned proportion of equipment manufacturing industry in Liaoning is obviously higher than the national average, and much higher than that of China's south-east coastal provinces. As to large-scale joint-stock equipment manufacturing enterprises in Liaoning, the proportion of state-owned holding is even surprisingly high. For example, the state-owned shareholding ratio of Shenyang Machine Tool Group is more than 90%, that of SBW is more than 75%, that of Brilliance Automotive Group is more than 50%, and that of Dalian Shipbuilding Industry Corporation is close to 45%. The high proportion of the state-owned economy in Liaoning's equipment manufacturing industry leads to the slow development of market economy and restricts the vitality of equipment manufacturing enterprises. Especially compared with coastal cities and economically developed areas, there is a big gap in the awareness of opening-up and the sense of competition. It also leads to the lack of scientific management of enterprises, which can't provide advanced technology and equipment applications with ideal supporting conditions, making research and development, production, marketing and after-sales service can't have a coordinated development.

Table 3 Paid-in capital structure of the equipment manufacturing industry in China (2015)

Sectors	paid-in capital	Proportion（%）					
		State capital	Collective capital	Corporate capital	Personal capital	Capital of Hong Kong, Macao and Taiwan	Foreign capital
Special equipment manufacturing industry	6958	14.9	1.4	32.0	32.3	5.4	13.9
Electrical, mechanical and equipment manufacturing industry	12242	5.5	1.8	36.0	38.9	6.4	11.3
Transportation equipment manufacturing industry	343	60.8	0.3	30.4	3.8	0.4	4.4
Metal products manufacturing industry	6610	6.5	1.6	27.6	46.5	7.9	9.9

Computer, communications and other electronic equipment manufacturing industry	13990	8.0	2.3	31.8	11.5	16.8	29.2
General equipment manufacturing industry	8140	8.5	1.4	33.2	33.9	5.4	17.6
Instrumentation and culture, office machinery manufacturing industry	1525	8.5	1.3	30.4	36.4	9.3	15.0
Equipment manufacturing industry	49808	8.6	1.8	32.5	30.2	9.3	17.6

Data sources: China Industrial Statistics Yearbook (2016).

Table 4 Paid-in capital structure of the equipment manufacturing industry in Liaoning (2015)

Sectors	paid-in capital	Proportion（%）					
		State capital	Collective capital	Corporate capital	Personal capital	Capital of Hong Kong, Macao and Taiwan	Foreign capital
Special equipment manufacturing industry	345	27.5	0.3	34.1	18.1	0.1	19.9
Electrical, mechanical and equipment manufacturing industry	247	4.4	3.3	39.7	31.4	2.4	18.9
Transportation equipment manufacturing industry	3822	42.8	1.0	28.8	17.1	2.2	8.1
Metal products manufacturing industry	224	6.8	2.5	34.2	28.5	13.3	14.8
Computer, communications and other electronic equipment manufacturing industry	245	8.0	0.4	47.8	6.0	19.9	16.2
General equipment manufacturing industry	481	18.7	1.4	30.1	27.6	1.9	20.3
Instrumentation and culture, office machinery manufacturing industry	42	4.2	1.3	28.4	43.7	1.5	20.9
Equipment manufacturing industry	5407	34.5	1.1	30.9	19.0	3.3	11.2

Data sources: China Industrial Statistics Yearbook (2016).

5. Internationalization level needs to be further improved

43. Although the equipment manufacturing industry in Liaoning has made remarkable achievements in the process of outward foreign direct investment with its unique regional characteristics, economic conditions and trade characteristics, there are also many problems. In 2011, the net growth rate of outward foreign direct investment of the equipment manufacturing industry in the Province was 33.8%, which slowed down year after year and dropped to a negative growth range. In the recent five years, the net outward FDI of equipment manufacturing industry accounted for 6.8%, 9.4%, 9.9%, 6.7% and 7.8% respectively of the total net outward FDI in the province. The proportion picks up after the drop, but shows a slow recovery trend. The "going global" of Liaoning equipment manufacturing industry encountered a bottleneck.

44. Enterprises engaged in outward foreign direct investment is short of vitality. The enterprises engaged in outward foreign direct investment in Liaoning are mostly strong state-owned large enterprises, the proportion of overseas investment of which is 65%. Relatively speaking, the proportion of private enterprises in outward foreign investment and cooperation is relatively low - 30% only. The inefficient allocation of a large number of state-owned assets and the aging state of production equipment lead to lower production efficiency, and the enterprises are at a disadvantage in the market competition.

45. The value added of key links in the industrial chain is not high enough. The industry chain is made up of different interlocking chains. Enterprises do not only provide products but also involve R&D, design, service and so on. These are the factors that improve the level of product specialization and value added of products. The value added of production links in Liaoning's equipment manufacturing industry is low, which is at the low end of the "smiling curve". The R&D innovation needs to be improved, and the high-end service such as R&D and planning is still in its infancy.

46. The foundation of international cooperation remains to be consolidated. The "going global" of Liaoning's equipment manufacturing industry and cooperation with international enterprises are still at the initial stage, and it also faces obstacles and challenges from the environment, institution, technology, culture and so on. The state-owned enterprises account for a large proportion of Liaoning, their operation system becomes rigid seriously, and they are short of experience in the international market competition.

6. The level of technological innovation is low

47. Technological innovation plays a key role in the development of equipment manufacturing industry. R&D expenditure is a core indicator used to evaluate technological innovation capability and the level of the technological innovation input in China's R&D spending. In 2014, the research spending of Liaoning's equipment manufacturing industry is 26.34 billion CNY, accounting for 7.3% of the national total, only about 30% of that of the top provinces. In 2014, there are 31,032 scientific research projects in the manufacturing industry of Liaoning Province, with an expenditure of 17.536 billion CNY. These two indicators are 17.2% and 6% of the national total and in the middle of the national rankings, but it is far from enough. In 2014, the enterprise technology import expenditure in China is 49.631 billion CNY and the expenditure for technology absorption is 17.65 billion CNY, which falls behind of developed countries. It can be seen that there is still deficiency in technology innovation in Liaoning's equipment manufacturing industry. The number of patent applications is also an important indicator of technological innovation. In 2014, the large and medium-sized

industrial enterprises in Liaoning have applied for 4,468 patents, including 1,596 invention patents and 2,761 available patents, accounting for 2.3%, 1.9% and 1.77% in China respectively. This also shows Liaoning's lack of independent innovation capability in the field of equipment manufacturing, which is mainly attributable to the lack of technological innovation factors.

7. The degree of informatization is not high enough

48. In January 2016, the Machinery Industry Information Research Institute issued the *China (Fully-covered Range) Equipment Manufacturing Industry Regional Competitiveness Evaluation Report (2014)*. The report gives an evaluation of the regional competitiveness of the equipment manufacturing industry, including four important aspects, namely scale & strength, economic efficiency, internationalization level and innovation ability. In the range of equipment manufacturing industry, the full-covered range used in the report is beyond the traditional division. According to the traditional division, the equipment manufacturing industry includes metal products industry, general equipment manufacturing industry, special equipment manufacturing industry, automobile manufacturing industry, railway, marine, aerospace and other transportation equipment manufacturing industry, manufacture of electrical machinery and apparatus, manufacture of measuring instruments and machinery , as well as investment products and some products with dual attributes of consumption and investment in the metal products, machinery and equipment repair industry. While in the full-covered range, it includes not only the traditional division of equipment manufacturing industry, but also the investment products in the computer, communications and other electronic equipment manufacturing industry. Therefore, expanding to the full-covered range makes the evaluation better reflect the regional development of the information equipment manufacturing industry and the level of information, digital, intelligent and high value-added technology integration of the equipment manufacturing industry. However, the development of information equipment manufacturing industry and the capability of equipment manufacturing industry carrying information technology in Liaoning are not enough, and the deep integration of informatization and industrialization needs to be improved.

Table 5 Evaluation ranking of Liaoning and other provinces (municipalities) in the full-covered range of equipment manufacturing industry

Ranking	Scale strength		Economic efficiency		Innovation ability		International Competitiveness	
	Full aperture statistics	Traditional aperture statistics	Full aperture statistics	Traditional aperture statistics	Full aperture statistics	Traditional aperture statistics	Full aperture statistics	Traditional aperture statistics
1	Jiangsu	Jiangsu	Jilin	Jilin	Beijing	Beijing	Guangdong	Guangdong
2	Guangdong	Shandong	Shandong	Shandong	Jiangsu	Jiangsu	Jiangsu	Jiangsu
3	Shandong	Guangdong	Shanghai	Shanghai	Zhejiang	Zhejiang	Shanghai	Zhejiang
4	Zhejiang	Zhejiang	Jiangsu	Jiangsu	Anhui	Guangdong	Zhejiang	Shanghai
5	Henan	Liaoning	Tianjin	Henan	Guangdong	Anhui	Shandong	Fujian
6	Shanghai	Henan	Henan	Beijing	Shanghai	Shanghai	Fujian	Shandong
7	Hubei	Anhui	Beijing	Jiangxi	Shandong	Shandong	Sichuan	Liaoning
8	Liaoning	Shanghai	Liaoning	Hubei	Sichuan	Sichuan	Tianjin	Anhui
9	Anhui	Hubei	Anhui	Chongqing	Shanxi	Shanxi	Chongqing	Tianjin
10	Sichuan	Hebei	Hubei	Liaoning	Liaoning	Liaoning	Henan	Jiangxi

Data sources: Evaluation report on regional competitiveness of China (Full aperture statistics) equipment manufacturing industry (2014).

IV. Environment for International Expansion of Equipment Manufacturing Industry in Liaoning Province

A. Favorable Environment for International expansion of Equipment Manufacturing Industry in Liaoning Province

49. The favorable factors for "going global" of Liaoning's equipment manufacturing industry, including the implementation of "the Belt and Road ", accelerating international expansion, building Northeast China into an important window for China's opening to the north and a hub for cooperation in Northeast Asia, and promoting the construction of free trade area between China and South Korea, are analyzed as follows.

1. International expansion has become an inevitable choice

50. In the trend of economic globalization and regional economic integration, countries and enterprises consider international development as an important economic development strategy. At present, the international development is in full swing. On the one hand, the infrastructure of the developed countries in Europe and North America has entered an upgraded stage; on the other hand, in the process of industrialization, the construction of infrastructure in developing countries has also formed a huge demand. Therefore, in the world market, there is a huge demand for equipment manufacturing products, elements and industry. At the same time, Liaoning's equipment manufacturing products, factors and industry have an obvious advantage in supply. Through international expansion, it can not only provide high quality equipment manufacturing products, factors and industry to developing countries, but also combine its comparative advantage in the manufacturing industry with the high-end technology of developed countries, actively participate in the global market competition and value chain reconstruction, and promote industrial transformation and upgrading. International expansion, as an international, inclusive and new cooperation model, will provide Liaoning's equipment manufacturing industry with an excellent opportunity in meeting the needs of the international market, building a global production and operation system, and deeply integrating into the global industrial chain, value chain and logistics chain. Of course, international expansion is not simply a shift of excess capacity.

2. "The Belt and Road" brings opportunities for international development of Liaoning's equipment manufacturing industry

51. It brings the demand for construction machinery due to infrastructure construction. "The Belt and Road" involves a lot of countries and regions in Asia, Europe and Africa, and the demand for urban infrastructure is very large.

According to the statistics of Asian Development Bank, by 2020, the infrastructure investment demand along "the Belt and Road" is up to 730 billion USD a year. Taking highway infrastructure as an example, in the past two years, nearly 50 excavators have been used in highway construction in Kyrgyzstan, the construction has gradually expanded from Central Asia and Eastern Europe to Southeast Asia, West Asia and North Africa, and there will be a growing demand for cranes, hoisting ships and dredging ships. There are a large number of equipment manufacturing enterprises related to this. For example, Sanyo Heavy Industry Group, Northern Heavy Industries Group, Dalian Shipbuilding Industry Corporation, CRRC Dalian Company and other leading equipment manufacturing enterprises can take this opportunity to be further involved in the international market and achieve their own upgrading and development by using the vast market space.

52. It provides an effective way to dissolve excess capacity. In December 2014, the meeting summary signed by and between China and Kazakhstan identified approximately 63 projects involving electricity, energy, iron and steel, road transportation and other fields. 52 capacity cooperation projects have been concluded so far, totaling more than 24 billion USD. Such a strategic cooperation has accelerated the pace of China's excess capacity "going global", and will also effectively promote the internationalization process of regional equipment manufacturing industry. Although the economic aggregate of equipment manufacturing industry in Liaoning has continued to grow in recent years, the industrial type is mainly labor intensive and resource intensive, the development of technology-intensive industry is lagging behind and added value of products is low, causing overcapacity. However, in those countries along the Belt and Road whose industries are underdeveloped, the infrastructure lags behind and the economic development is limited. If equipment manufacturing enterprises in Liaoning can cooperate with them, it will be a timely assistance and help to dissolve excess capacity.

53. It has created a new space for the growth of high-end equipment manufacturing. With the intensification of international competition and deepening of transnational cooperation, enterprises having the mature technology, high-quality products and strong management ability will become "strategic dividend" attracting much attention along the Belt and Road. The high-end equipment manufacturing industry is the key engine for equipment manufacturing industry "from big to strong". The quality, technology, service and reputation behind the high-end products, representing the image of a country or region, is the key to industrial transformation and upgrading as well as building the brand of "made in China". In recent years, Liaoning has started the implementation of more than 10 major projects of high-end equipment manufacturing. The *Outline of*

Liaoning's Action Plan for Made in China 2025 also puts forward to focus on the development of 15 key areas including high-end CNC machine tools, robots and intelligent manufacturing equipment, aerospace equipment, marine engineering equipment, advanced rail transportation equipment and so on. The research breakthroughs in key technologies and the application of major achievements will give the equipment manufacturing industry in Liaoning immeasurable growth space in the international market.

3. National policies have provided strong support

54. As the economy enters a "new normal", "the Belt and Road", "the Internet + manufacturing", the "13th Five-Year plan" and the "Technology Roadmap for Key Areas of Made in China 2025" have brought important opportunities for the development of China's equipment manufacturing industry. Firstly, at the government work conference in 2015, Premier Li Keqiang described the opportunities and challenges for the equipment manufacturing industry brought by "the Belt and Road", and hoped that the equipment manufacturing industry can take the opportunity to go abroad to make full use of the resources in the countries along "the Belt and Road", play their own advantages, integrate into the international market and become new highlights of economic growth. Secondly, China will vigorously develop "the Internet + equipment manufacturing industry". With the Internet platform, intelligent equipment will become the priority direction of equipment manufacturing enterprises. Thirdly, the "13th Five-Year plan" clearly puts forward that the strategic emerging industries including high-end equipment manufacturing will be the key direction of development. In the "13th Five-Year" period, the strategic emerging industries will focus on cultivating high-end equipment and materials. In the process of the development of high-end equipment manufacturing industry, the key strategic material industrialization and application is critical to its development; according to the latest plan, by 2020, China will vigorously develop key strategic materials to support the development of the high-end equipment manufacturing industry.

B. Unfavorable Environment for International expansion of Equipment Manufacturing Industry in Liaoning Province

55. At present, the new round revolution of science and technology and the rise of industrial transformation are reshaping the world economic structure. The widespread penetration of new-generation information technology has led to continuous breakthroughs, continuous convergence and accelerated the application of technology in key areas and is triggering significant changes in development concepts, technology systems, manufacturing models and value chains of the manufacturing industry. Developed countries and regions have implemented the strategy of "re-industrialization" and "manufacturing return",

trying to seize the high-end equipment manufacturing market and continue to expand competitive advantages; meanwhile, emerging economies are developing manufacturing industry by relying on their resources, labor and other comparative advantages; China's equipment manufacturing industry is facing new challenges of "backflow of high-end industries" from developed countries and "diversion of low and middle-end industries" from developing countries.

1. The demand of the international market and the increasing pressure of competition in the international market

56. At present, although the world economy continues to recover, the world economic recovery presents instability and uncertainty because of the uncertainty of the macroeconomic policies in major developed economies, the uncertainty of the European debt crisis, the growth uncertainty of emerging market economies and the regional structural instability uncertainty. As a result, the consumption demand in the international market is depressed and the investment demand is sluggish. At the same time, the implementation of "re-industrialization" development strategy of developed countries and the rapid development of equipment manufacturing industry in developing countries will bring more intense external competition pressure to the internationalization of Liaoning's equipment manufacturing industry.

2. The continuous accelerating of transnational operation and improvement in competitive power of other provinces

57. In recent years, with the continuous improvement of China's open economic development, the transnational operation in the provinces has been developing rapidly. Compared with some provinces, there are still some gaps in the transnational operation of Liaoning's enterprises. Taking the non-financial outward FDI in 2010-2014 as an example, it can be seen from Table 6 that the outward FDI (flow) in Liaoning ranks the top 10 at the end of 2010-2014, but the ranking has not changed, the scale of outward foreign investment is small, and the proportion is small. At the end of 2010-2014, the proportion of outward foreign direct investment (flow) in Liaoning ranking the top 10 is about 5%-7%, while that of Guangdong is 24.8%, 28.1%, 27.2%, 27.8% and 27% respectively, and that of Shandong accounted is 10.6%, 13.5%, 12.9%, 13% and 10.8% respectively. It can be seen from Tab. 6 that the outward foreign direct investment (flow) in Liaoning ranks the top 10 in 2010-2014, but the rankings are moving backward. The scale of overseas investment is small. The proportion shows a large fluctuation and a downward trend- it is only 3.4% in 2014. However, the proportion ranking the top 10 in Guangdong is 11.5%, 20.8%, 20.8%, 22.1% and 25.2% respectively, and that in Shandong is 13.6%, 14.2%, 13.6%, 15.9% and 9.1% respectively.

58. Therefore, Liaoning has certain advantages in outward foreign direct investment, but there are obvious gaps in both the scale and proportion compared with some coastal provinces and the provinces with late-mover advantages, and it is facing the pressures and challenges of competition.

Table 6 Outward foreign direct investment of Liaoning in 2010-2014

Year	Stocks by year-end			Annual flows		
	Ranking	Scale（hundred million dollars）	The proportion of the top 10（%）	Ranking	Scale（hundred million dollars）	The proportion of the top 10（%）
2010	7	27.16	7.3	2	19.36	14
2011	7	32.96	6.8	9	11.44	6.6
2012	7	41.33	7.5	5	27.63	10.9
2013	7	45.47	6.3	7	12.95	4.8
2014	7	92.3	5.1	8	14.79	3.4

Data sources: China Foreign Direct Investment Statistics Bulletin

3. The bottleneck of internationalization of Liaoning's equipment manufacturing industry becomes more apparent

59. In the development of Liaoning's equipment manufacturing industry, the bottleneck becomes more apparent. Taking 2015 for example, the major economic indicators of Liaoning's equipment manufacturing industry including prime operating revenue, profit, prime operating revenue profit margin, profits and taxes and value-added tax are lower than the national average. The bottleneck of the development of Liaoning's equipment manufacturing industry together with the downturn of world economy makes the situation of "going global" more severe. Taking Ansteel Group Corporation for example, it can be seen from Table 7 that at the end of 2008-2014, its overseas investment shows a downward trend in the aspects of stock ranking, asset ranking and sales income rankings.

Table 7 Basic indicators of Ansteel Group Corporation's overseas investment at the end of 2008-2014

Year	Inventory Rankings	Total Assets Rankings	Sales Revenue Rankings
2008	38	-	36
2009	33	-	39
2010	36	-	41
2011	37	57	39
2012	44	74	51
2013	47	62	43
2014	88	97	49

Data sources: China Foreign Direct Investment Statistics Bulletin

V. Priorities of International Expansion of Equipment Manufacturing Industry in Liaoning Province

A. Build the base of international equipment manufacturing industry and improve the international comprehensive competitiveness

60. To achieve international development of Liaoning's equipment manufacturing industry, it needs to further support enterprises enlarging and strengthening through mergers and acquisitions and promote the linkage development with production service industry, so as to build Liaoning into a base of international equipment manufacturing industry with outstanding international competitiveness and the comprehensive supporting capacity.

1. Enhance the supporting force of organization and coordination to promote the process of important technological equipment to become homegrown and upgrade further self innovation, centered around enterprises.

a) Enhance the policy support of acceleration to push forward the process of important technological equipment to become homegrown

61. Due to courses of large strength of input of broad areas of linkage and higher requirement of talents of technology of important equipments, it is difficult to push forward R&D through single enterprise, it is necessary to organize R&D and input of large amount at governmental level. The government must increase the input of cost of R&D of important homegrown equipment, establish incentive mechanism to promote homegrown trend in order to encourage homegrown equipments are used by consumers, manufacturing enterprises develop and produce homegrown equipments actively; the state should give preferential policies of arrangement of capital and interest of credit to those engineering projects related to home • made raised by domestic equipment manufacturers and should implement priority of purchasing policy to state invested engineering project with products that domestic manufacturing industry has no competitive advantage yet even under same conditions; for state invested public construction projects, policy of priority in using domestic products should be implemented, and this policy can also be guided through fiscal subsidy of interest; the government should provide guarantee of risks for first set of domestic products. R&D of important equipment of manufacturing industry requires very high investment in general, but it is also with high risks, that is the reason of less private capital to be involved. Therefore, it is very necessary to establish risk fund to support R&D of important equipment.

b) Upgrade technological level of enterprises through various means

62. The first, attract the foreign enterprises to become shareholders with their technology to be shares, to participate the construction of domestic important programme and important engineering projects while the domestic enterprises have the controlling stake based upon the principle “With market change technology.” The state should provide conditions for bidding manufacturers that they must joint tender with qualified domestic enterprises, foreign enterprises winning the bidding should transfer technology and subcontract production to domestic enterprises. The contract of import of equipment and the contract of transfer of technology shall enter into force at the same time. It is necessary to digest a set of advanced technology through accomplishment of a project, and through the digestion and absorption of the imported technology to achieve the second development, thereby to possess the core technology with independent intellectual property rights, and master the whole process of design, R&D, testing, processing and manufacturing, installation and maintenance actively. The second, governmental departments should give preferential policies such as financial support of interest discount loan to R&D of basic components of manufacturers of basic machinery, and the manufacturer of basic machinery should establish long term strategic coordinative partnership with enterprises in manufacture of parts and components of accessories of the basic machinery. The enterprise group of basic machinery should support the manufacturers of accessory of their basic machinery with capital and technology to strengthen their productive capability. To enhance the capacity of exploration of market and R&D through guidance and support of policies, reorganization of assets, or to establish large scale enterprise group in manufacture of basic parts and accessories through mergers. The third, encourage deepening reform of R&D institutions of enterprises, vitalize the potential of various major actors of innovation, to upgrade the initiative of technological personnel through various incentive system. Guide the enterprise to adopt the model of “Innovation by whole members”. i.e. to mobilize all employees to participate the process of innovation of technology and process through forms of bidding of technology and process, competition of innovation of technology and processing to reduce cost of production and upgrading the competitiveness of enterprises.

2. Support mergers and reorganization of enterprises, upgrading the concentration ratio, strengthening the dominant role of equipment manufacturing industry in regional industry.

63. To build Liaoning into a world-class advanced equipment manufacturing base, we must foster a batch of large equipment manufacturing enterprise groups with a sales revenue of 100 billion CNY and above, support backbone equipment manufacturing enterprises to carry out merger and reorganization, develop large

enterprise groups and support the new development of equipment manufacturing industry in Liaoning with large enterprises.

a) Accelerate the strategic restructuring of enterprises and increase industrial policy support

64. Actively expand and develop large and super large industrial enterprises, develop large enterprises with engineering contracting, system integration, international trade and financing capacity, improve industrial concentration, and enhance international competitiveness of industry. Actively promote the strategic restructuring of state-owned backbone enterprises; focus on large backbone enterprises of machine tools, shipbuilding, marine engineering, power transmission, automotive and other industries,

65. Promote cross-regional, cross ownership and cross-industry combination and reorganization of enterprises by merger, combination and other means etc., so as to achieve the integration of resources and optimal allocation. Determine and implement rational industrial organization policies, increase support to pillar industries and advantageous enterprises, enhance the concentration of pillar industries, make big enterprises bigger and stronger to realize the maximum concentration; make the small business more specialized and more in quantity to form the most competitive situation as possible; promote and guide the coordinated development of enterprises of different scale in the industry by supporting advantageous enterprises, get the production linkage among enterprises closer and improve the professional level.

b) Focus on promoting several enterprises to reach world-class level

66. To make the equipment manufacturing industry in Liaoning becomes an international competitive industry, there should be more than one pillar enterprise of the secondary or tertiary industry with an output value or sales revenue reaching 10% of the world's industry or above.

67. At present, the shipbuilding industry in Liaoning is expected to account for more than 10% of the world's shipbuilding industry and become a world-class shipbuilding industry base. The output of machine tools and CNC machine tools in Liaoning has accounted for more than 10% of the national total, and China's machine tool production accounts for 12% of the global total; although it ranks the third in the world, the proportion of Liaoning's machine tool and CNC machine tool production out of the global total has not yet reached the level of a world-class base, and the grade of the products also needs to be further enhanced. From the view of the current trend of the global machine tool industry transfer, if it maintains the current growth momentum, after several years of efforts, it is possible for Liaoning to achieve the goal of building a world-class

machine tool industry base. If the above two industries have reached the development level of a world-class base, they are bound to promote the upgrading of a number of related secondary industries and promote Liaoning to gradually become an international equipment manufacturing base.

c) Strengthen the leading position of equipment manufacturing in regional industry

68. From the late 1970s to the early 1980s, Japan's manufacturing industry formed an economic primacy, and its value added of machinery and transportation equipment manufacturing accounted for 40% of the industrial value added. The output structure of other manufacturing powers is similar – that of Germany and the United States are both about 40%. At present, the added value of equipment manufacturing industry in Liaoning accounts for about 30% of the value added of industrial manufacturing above designated size. Compared with the structural proportion of Japan, Germany, Britain and the United States as the world equipment manufacturing industry bases, this means that if we want to build Liaoning into an international competitive equipment manufacturing base, the proportion of the equipment manufacturing industry in Liaoning accounted for the regional manufacturing industry should increase at least more than 10% (as a specialized region and the proportion of the country's structure, its main industry share should be higher).

3. Extend the service connotation of manufacturing industry, make the equipment manufacturing industry develop to "post-industrialization", and speed up the development of high-end producer services

69. Post-industrialization is characterized by the continuous expansion and extension of the services of the manufacturing enterprises to the upstream and downstream sectors of the enterprise, deeming services as the source of creating new value, the constantly improving proportion of service in the sales of enterprises and even gradually becoming the main part of corporate profit beyond the equipment manufacturing.

a) Promote the integration of and interaction between producer services and equipment manufacturing industry

70. For Liaoning, which is building an advanced equipment manufacturing base, the lagging development of producer's service will become the bottleneck of enhancing the competitiveness of equipment manufacturing industry. Therefore, it must make great efforts to promote the development of producer services, give full play to its important role in upgrading the manufacturing structure, and enhance the interaction between them. Specifically, it should improve the technological innovation ability of equipment manufacturing industry through

independent research and development activities, build a famous brand of manufacturing products at home and abroad through the development of the design industry, provide a stable source of funding for industrial technology innovation by the tilting support to the financial industry, improve the competitiveness of manufacturing industry through the electronic commerce and trade and reduce the operation cost of manufacturing enterprises by promoting the development of high-end third-party logistics industry.

b) Create a favorable environment for the development of producer services and increase policy support

71. The life services can mainly depend on the market supply; while for producer services, it should give full play to the guiding role of the government. Liaoning should create a favorable environment for the development of producer's services so as to attract investment of domestic and international producer's services enterprises and promote the growth and expansion of local enterprises. Firstly, prepare producer's services development plan and special plans for the development of key fields, make clear the development goal, key industries and layout orientation of producer's services, give full consideration to the land needs of the development of producer services, make a reasonable arrangement of development space, and promote the development of cluster of producer's services. Secondly, accelerate the development of several producer industry cluster areas of distinctive characteristics, and promote service enterprises of common position and strong industry relationship to gather in cluster areas, achieving the centralized layout, intensive land use and industrial agglomeration. Thirdly, increase support of taxation and other policies to producer's services. Guangdong, Tianjin, Jiangsu, Sichuan and other regions have introduced preferential policies specifically for the producer's services, which do not only provide preferential policies in the supply of land, water and gas, but also in tax within the bounds of the State, e.g. increase of the pre-tax deduction in the technical development costs, employee training funds, etc. Liaoning should also make efforts to increase policy support in such areas.

4. Improve the level of equipment manufacturing industry cluster and build a new national industrial base

72. Accelerate the innovation and development of equipment manufacturing industry in Shenyang Economic Development Zone taking Shenyang as the center and the coastal economic belt leading by Dalian, promote the in-depth cooperation of the two major areas to drive the common development of characteristic equipment industry in Northwest Liaoning, forming an industrial structure of dual core drive, coordinated development of the land and the sea and flourished development of many industrial clusters.

73. Shenyang Economic Development Zone: Give full play to Shenyang's advantage of having solid industrial foundation, concentrated scientific research force and developed modern service industry, highlight the leading role of Tiexi equipment manufacturing industry cluster as a demonstration zone of national old industrial base comprehensive reform and equipment manufacturing development, focusing on intelligent equipment, new energy equipment, heavy equipment, new materials technology and equipment and other key fields, promote the Shenyang Machine Tool Group, North Heavy Industries Group, SBW, Yuanda Group, TBEA and other leading enterprises to keep up with the international first-class enterprises, and lead the industry to upgrade. Give full play to the advantages of Shenyang as the center, take Tiexi equipment manufacturing industrial cluster as the core and take Hunnan Intelligent Park as the support to drive the rapid development of characteristic industrial clusters including Fushun intelligent equipment industrial cluster and Anshan laser electronic and automation equipment industrial cluster.

74. The coastal economic belt: Give full play to the industrial advantages, technological advantages, opening-up advantages of and port vicinity advantages of the coastal economic belt leading by Dalian, highlight the leading role of the Dalian Bay coastal equipment manufacturing industry cluster and Jinzhou equipment manufacturing industry cluster, focus on the intelligent equipment, marine engineering, large-scale petrochemical equipment, major complete equipment and other leading industries, promote Dalian Machine Tool Group, Dalian Huarui Heavy Industry Group, DSIC, CFHI Dalian Hydrogenation Reactor Manufacturing Company and other leading enterprises to keep up with the international advanced standards, and lead the industry towards the transformation and upgrading of integration, intelligence and internationalization. Take the two industrial clusters as the core to promote the rapid development of the characteristic industrial clusters including Lushun ship supporting industry and Wafangdian bearing industry. Play the leading role of Dalian to lead the common development of Dandong instrument industrial cluster, Panjin oil and gas equipment industrial cluster and Huludao marine engineering industrial cluster, and build an important growth pole of equipment manufacturing industry in line with Shenyang Economic Development Zone and new equipment manufacturing base with obvious international characteristics.

75. Northwest Liaoning. Fully improve the scale and technical level of the special industrial clusters of the Tieling special vehicles, Tieling valve, Tieling County auto parts, Tieling petroleum equipment, Kaiyuan crane, Changtu heat transfer equipment, Diaobingshan coal mining equipment and Fuxin hydraulic parts, and promote industrial restructuring and technological upgrading. Speed up the development of the automotive and parts industry, promote the development of

new energy vehicles and EV batteries, realize the transformation and upgrading of the industrial economy in Chaoyang, and constantly expand the strength of industrial cluster development.

5. Accelerate the upgrading of enterprise capacity in producing whole sets of equipment and general contracting

76. To further improve the international competitiveness of Liaoning's equipment manufacturing industry, there must be a batch of leading enterprises in the aspects of producing whole sets of equipment and EPC. Considering the existing foundation in Liaoning, the following aspects should be further promoted: complete industrial chain of power transmission and transformation equipment, whole sets of metallurgical and petrochemical equipment, new energy equipment, energy-saving and environment friendly equipment, etc. The heavy equipment manufacturing industry should aim at the major and key equipment urgently needed by the State and to achieve import substitution, strengthen the ability of independent research and innovation, actively develop the main process equipment and supporting equipment, improve the level of complete sets, so as to build Liaoning into a major equipment manufacturing base.

77. Build a complete industrial chain of power transmission and transformation equipment. Taking 1000KV AC, ± 1100KV DC high voltage, high capacity, intelligent power transmission and transmission whole sets as the main direction, speed up the independent innovation and structural adjustment, strengthen key products including transformer, sulfur hexafluoride enclosed switchgear, transformer, high voltage bushing, wire and cable and secondary control device, and build the power transmission equipment manufacturing industry chain integrating engineering design and international logistics. Speed up the construction of Northeast China power transmission and transformation technology industry park project. Based on the brand advantage established in South and Central Asia countries, promote the development of the international market by taking advantage of “the Belt and Road Initiative”.

78. Improve the capability of manufacturing whole sets of metallurgical and petrochemical equipment. Taking the "major equipment and whole sets of high-end equipment" as the main direction, develop machines, pumps, process automation instrumentation control system for megaton ethylene unit, megaton PTA device and PX device, large liquefied natural gas equipment, large coal chemical equipment, large oil refining equipment, long distance pipeline equipment for oil and natural gas, ocean and onshore oil drilling equipment, oil fracturing unit, etc. in petrochemical equipment in key areas. In the field of whole sets of metallurgical equipment, focus on the development of whole sets of high

performance ultra wide and thin magnesium alloy plate rolling equipment, medium & thick steel plate precision shearing series unit, high yield pellet firing machine, complete sets of equipment, large-type sintering machine, large-type high efficiency cold and hot rolling mill and other products. Promote cross-specialty technical exchange, enhance integrated innovation capability, and achieve efficient operation, good matching and intelligent control of complete sets of equipment. Promote the all-round and in-depth development of project general contracting, regional general contracting, re-manufacture and post service, and speed up the transformation from single machines, single sets to complete sets of equipment, general contracting and producer's services.

79. Accelerate the development of new energy equipment. Seize the opportunity of developing domestic nuclear power, promote the process of nuclear island equipment manufacturing industry alliance development, aim at the main technical direction of AP1000 and CAP1400, follow up the technology development of Hualong One, and create the key nuclear island equipment production base with most complete industry chain and powerful technology in China. Speed up the development of 2.5 MW+ onshore wind turbines and key components and 5 MW+ offshore wind turbine and the key components, and strive to achieve a major breakthrough in wind turbine design technology, wind turbine blades, main bearings and control system development technology. Develop solar modules of high conversion rate, flexible multi terminal HVDC system, high power photovoltaic inverter, large capacity storage devices and distributed photovoltaic grid power plant products, and promote the industrial application.

80. Promote the premiumisation of engineering machinery. Based on the needs of the construction of key national projects, focus on the development of the whole section series tunnel boring machine (TBM), the cutters and control system, large-type and efficient mining equipment, large-type loaders, efficient road construction and maintenance machinery, multifunctional large wheeled crane, large all-terrain truck crane and other high-end engineering equipment. Accelerate the development of multi-purpose serialized high value-added construction machinery products. Implement a number of key projects of engineering machinery and road maintenance machinery, and focus on the development of high precision and high efficiency tamping wagon, high efficiency screening machine, high efficiency screening machine, ballast bed comprehensive treatment car, rail grinding and milling car, rail-defect detector car, comprehensive inspection car, high-speed track inspection car, etc. Strengthen the construction of supporting system, develop electro-hydraulic shift transmission, wet braking driving axle, integral multi-way valve, open-type system straight through axial plunger pump, hydraulic motor and other ancillary

products, realize the localization of engineering machinery core components, enhance the independent innovation capability of high-end engineering equipment, and promote the market application.

81. Promote the development of energy saving and environmental protection equipment manufacturing industry. Focus on the development of energy efficient motors, variable frequency speed control technology, reactive power compensation technology and equipment, energy management system, high/low voltage intelligent power saving system, low loss substation technology, residual heat/pressure/energy power generation technology, and industrial wastewater, solid waste, hazardous waste and other solid waste treatment technology. Centering on the waste gas emission control of coal-fired power plants, iron smelting blast furnace, life waste incineration, etc., accelerate the development of professional treatment technology and equipment of desulfurization, denigration, demercuration, dust emission and dioxin treatment, extend from the terminal control to the source control, and promote the systematization and complete sets of treatment equipment.

82. General contracting capacity refers to getting the related design and manufacturing enterprises together to provide turnkey projects. Liaoning still lacks world-class equipment giants such as GE, Siemens, Mitsubishi Heavy Industries and Alston, which provide full system services. Speeding up the development of large-scale equipment manufacturing enterprises with overall design, system integration, complete production and supporting services is the key link in occupying the commanding heights of competition in the international and domestic markets. Enterprises should strengthen the industrial engineering system design, equipment manufacturing, installation and commissioning, customer service services in areas such as the integration of resources, strengthen manufacturing and technical cooperation with foreign companies or large group cooperation, and joint design, improve the heat processing, heat treatment, automatic control system and the weak link of the technical level, the establishment of large engineering company has always the contracting capacity, and actively participate in international competition in the domestic market.

B. Seize the opportunity of "The Belt and Road" and speed up "going global"

83. In the new international economic situation, Liaoning's equipment manufacturing industry should seize the opportunity of "The Belt and Road" to speed up the "going global"; it needs to further optimize the product structure and regional layout, operation innovation and financing mode, and enhance the ability to

adapt to the international expansion of enterprises and prevent risks in transnational management.

1. Push forward construction of the strategic passage of sea, land and air to the outside world

84. Open upon the connection of strategic passage related to “The Belt and Road”, accelerate to construct network of interconnection and interworking, perfect the three-dimensional (sea, land, air) logistics custom system. The first is to construct comprehensive transportation route, which connects Dalian, Yingkou and Panjin-Manzhouli-Russia-Europe, starts from Dalian Port, Yingkou Port and Panjin Port, assisted by Liaoning-Shandong land-sea-freight roll-drop-pull transportation route, able to integrate functions of the ports for cargo transshipment. The second is to build a rail channel from Jinzhou Port, Panjin Port and Dandong Port to Choibalsan, Mongolia, as well as a large-scale channel towards Europe (Liaoning-Mongolia-Europe routes). The third is to accelerate the construction of Dalian international shipping center in Northeast Asia, and to push forward construction of the Arctic-Northeast shipping routes, which starts from Liaoning Port, goes through Chukchi Sea, East Siberian Sea and the Barents Sea, ends in the Bering Strait, as well as a maritime passage (Liaoning-seaway-Europe routes) going through the South Sea and Indonesia, covering the South Pacific Region. Through the construction of comprehensive transportation routes, the development cross-border transport by land and sea, the promotion of trade and investment, development of the equipment manufacturing industry will be promoted.

2. Further optimize the regional structure of "going global" in equipment manufacturing industry

85. Over the years, the equipment manufacturing industry in Liaoning has been expanding the international market in the transnational operation. At present, Liaoning should promote the diversification of the market and at the same time, focus on the layout of “The Belt and Road Initiative". "Going global" of industrial equipment manufacturing in Liaoning has its internal demand, and the complementarity of industrial structure between the countries along "The Belt and Road Initiative" and Liaoning gives it the advantages of strong exogenous demand. Especially with the construction of Liaoning-Manzhouli-Europe, Liaoning-Mongolia-Europe, Liaoning-seaway-Europe routes and China-Mongolia-Russia economic corridor, countries or regions along "The Belt and Road Initiative" should become the important regional layout for Liaoning's equipment manufacturing industry "going global". Therefore, Liaoning should actively integrate into the opportunities brought by “The Belt and Road Initiative”.

3. Further optimize the product structure of "going global" of equipment manufacturing industry

86. Considering the advantages and disadvantages of the equipment manufacturing industry in Liaoning "going global" and the development trend of international market equipment manufacturing industry, Liaoning needs to further strengthen the close cooperation of government-industry (enterprises)-universities-scientific research institutions, and give full play to the government's support effect, industry or enterprise, main effect the synergistic effect of universities and research institutions in the development and product innovation. Thus it can further enhance the development and product innovation ability, so that the equipment manufacturing industry in Liaoning can play, in the multinational management, its comparative advantages, and is conducive to the strategic basis to the high-end, intelligent manufacturing equipment, and seize the high point of the world's equipment manufacturing industry.

4. Carry out extensive exploration of the middle-end international market

87. After the implementation of the re-industrialization strategy in Europe and North America, the international demand for equipment manufacturing industry has dropped, and the growth potential of China's heavy equipment manufacturing demand in Europe and North America has been limited. However, some middle income developing countries or Middle East regions, such as Brazil, India, Iran and Turkey, have been facing stiff demand for heavy equipment manufacturing because of their own construction and mining needs. After the financial crisis, they have increased the international demand for equipment manufacturing products. These countries are basically mid-end market, and because of the political, construction and other factors, their demand for equipment manufacturing products in China has been increasing. In the Middle East market, the market power of the western mainstream brands is weak, and it is easier for Liaoning's equipment manufacturing products to enter these countries' markets. On one hand, the Middle East market belongs to the middle-end market, there is a large space for growth in the product prices, and they trust the quality of Chinese products; for Liaoning's equipment manufacturing enterprises, the profits are much higher than sales in the low-end market. On the other hand, the possibility of trade friction due to products entering into the middle-end market is relatively small, and the trade environment is relatively good.

5. Innovate the operation and financing mode further

88. In the modes of enterprise "going global", especially in the foreign contracting project, the contractor's participation in overseas projects is previously reflected in the labor subcontracting, construction subcontracting and construction management general contracting mainly. Although these modes can bring considerable revenue for enterprises, but the one-time property of "evacuation upon finish" can't bring sustainable cash flow for enterprises and is not conducive to enterprises to drive their products, technology and service "going global" integrally, and it wastes a lot of resources because the enterprise income is based on the bidding and bid winning time and again. At present, many developed and developing countries make extensive use of the BOT and PPP modes for construction project, e.g. in the developed countries such as the UK, Australia, the United States, Spain, Germany and France, the scale and management of PPP have reached a considerable level, and the European PPP market is the most developed. The reality and Liaoning's integration into the "The Belt and Road Initiative" fit with each other and complement each other, and it provides an excellent opportunity to Liaoning's equipment manufacturing industry "going global". Liaoning's equipment manufacturing industry shall seize the opportunity, take risks to innovate and explore new management modes, make full use of the new model produced by the contemporary world economy, especially the PPP mode, form a new profit mode taking the full participation including project development, design, financing, construction, equipment procurement, commissioning and operation, maintenance and management as precondition, centering on long-term, stable and sustainable development and aiming at the integrated export of products, technology and service integration, thus also achieve the enterprise role transformation from contractor to investor, which is conducive to the international expansion of enterprises.

6. Further enhance the ability of enterprises to adapt to international operations

89. Enterprises are carriers of transnational operation, and everything is idle talk if the enterprises do not have the ability of transnational operation. Firstly, enterprises should set up the concept of internationalization, strengthen the global thinking, and fully understand the strategic significance of transnational operations. Secondly, enterprise should form the organizational structure which adapts to the transnational operation. The characteristics of the development of the world economy and the development of contemporary transnational corporations show that the traditional bloated and inefficient organizational structure has been impacted, reducing the level of compression, and the flat organization structure that reduces the hierarchy and size has become a trend, which reduces not only the cost but also the delay between decision and action,

accelerates the response to changes in market and competition dynamics, so that the organization's ability becomes flexible and more responsive. It can be said that flexible organizational structure is necessary for enterprise's transnational operation to win in the changing environment. Lastly, enterprises should make full use of "the Internet+" strategy, and make the information resources flow freely between the parent and subsidiary companies, effectively mobilize the enthusiasm of each subsidiary within the network, and implement the global network structure deeply, so as to adapt to the complicated and changeable international market.

7. Further enhance the ability of enterprises to guard against risks in transnational operations

90. Transnational business enterprises will face many risks, including political risk of unstable political situation and regime change in host countries and the change of political relations in the source country; institutional risk of policy and legal environment changing as well as the lack of uniformity and transparency; security risks arising from war, unrest or conflict; economic risks brought by the change of international market factors and exchange rate fluctuations; social risks arising from differences in values and customs, etc. Among these risks, some kinds of risks are predictable and controllable, so a risk early-warning mechanism should be established. In view of the different risk categories and causes, the establishment of risk monitoring, identification and evaluation mechanism, especially for key countries and key industries should be so, in order to carry out risk early warning. And for some unpredictable and uncontrollable risks, effective overseas investment protection mechanism should be established and improved.

C. Promote international capacity cooperation and resolve excess production capacity

91. To promote international capacity cooperation, in the short term, is an important strategic measure for Liaoning to crack down the economic growth predicament and resolve the overcapacity crisis in equipment manufacturing industry. In the long term, it is an important way to adjust economic structure and upgrade the industrial structure of Liaoning Province, which helps to promote the opening up of Liaoning Province and further enhance the core competitiveness and the new international competitive advantage of enterprises engaged in equipment manufacturing industry.

1. Construct overseas industrial parks

92. Give full play to the competitive advantages of equipment manufacturing industry in Liaoning Province, actively encourage and guide enterprises to set up factories abroad, gradually form a number of overseas enterprise clusters and industrial parks, and constantly deepen international expansion. The first is to push forward the construction of the four overseas equipment industrial parks along 'The Belt', including Petrochemical Industrial Park in Republic of Bashkortostan, Russia, Yuanda Industrial Park in Kazakhstan, Holt Industrial Park in Mongolia, Liaoning Industrial Park in Romania, to promote export trading of equipment and technology of petrochemical, covering markets in Russia, Belarus, Eastern Europe and Central Asia, improving the level of cooperation between Liaoning and Central and Eastern Europe. The second is to propel the construction of the three overseas equipment industrial parks along 'The Road', including Indonesia-Liaoning Ferronickel Integrated Industrial Park, TBEA Green Energy Industrial Park in India, Uganda-Liaoning-Shenyang Industrial Park, to promote export trading of sets of equipment of electricity, mining and metal and construction materials industry, to strengthen and expand power transmission and new energy market in and around India, and to promote industrial transfer of automobile and relative industry, changing from production export to industrial export.

2. Undertake foreign equipment manufacturing projects

93. Through cooperation with the central institutions and enterprises directly controlled by the central authorities, etc., actively promote the equipment manufacturing enterprises in Liaoning Province to participate in foreign railways, high-speed railways, airports and other infrastructure construction and driven the Province's equipment manufacturing industry to go global. Actively undertake large-scale national foreign aid projects with high technical content and can drive the export of equipment in Liaoning Province, so as to drive the export of large sets of equipment in the Province. Support China Railway No. 9 Group to participate in the construction of the Erenhot-Ulan-Ude alternate railway lines project, the construction of Turkey cement plant project undertaken by North Heavy Industries Group, the project of 2 sets of 25000 kW thermal power stations in Laos contracted by Shenyang Yuanda Group, and the city water and gas supply project construction in Kenya and Zambia contracted by NEPC.

3. Acquire overseas enterprises

94. According to the requirements of the *Detailed Rules for the Reform of Foreign Exchange Management Reform in Liaoning Province*, publicize the latest

overseas M&A policies to enterprises in a timely manner, coordinate and promote the acquisition of overseas enterprises by enterprises in Liaoning province using foreign exchange reserve, and fully support the competitive manufacturing enterprises of the Province to carry out overseas mergers and acquisitions. Encourage the competent equipment manufacturing manufacturers in the Province to participate in overseas mergers and acquisitions through equity participation and acquisition and other means; encourage equipment manufacturing enterprises in the Province to establish overseas research institutions and design centers by sole proprietorship, joint venture, cooperation and other ways. Focus on promoting the implementation of large state-owned backbone equipment manufacturing enterprises and high-tech overseas M&A projects.

D. Achieve rise in global value chain and enhance profitability

95. At present, many equipment manufacturing industries in Liaoning are still at a low or "peripheral" division of labor in the global value chain, namely, production and assembly links of low technology and low value added. We should change this backward position in division of labor. Liaoning's equipment manufacturing industry should expand both upstream and downstream of the global value chain, enhance downstream channels and brand capabilities and upstream innovation capabilities, reverse the disadvantage of being locked down at the low end, and then improve profitability in the global value chain.

1. Enhance downstream profitability

96. The dominant transnational corporations in the global value chain occupy an absolute advantage in the distribution of international division of labor through occupation of critical value links, but this doesn't mean that the equipment manufacturing industry in Liaoning has to be at the bottom of the global value chain. Since 1990s, the shape of the global value chain has changed a lot. In the global value chain, the value added proportion of midstream including processing, assembly and manufacturing has been declining, and the trend of proportion increase of value added in the upstream including R&D and design and the downstream including channels and brands is increasingly evident. More importantly, there is evidence that the value-added rate of channels and brands in the downstream of the value chain exceeds the R&D link in the upstream to a certain extent. There are two main causes for the midstream and downstream of the global value chain to become the most profitable areas: on one hand, in the current international division of labor, the strength comparison between the manufacturing and the circulation industry has been reversed. In the early stage of industrialization, the circulation depends on manufacturing,

while at the late stage of industrialization, it has experienced a change from the sellers' market to buyer's market, the dependence on manufacturing circulation is greatly enhanced, and the circulation rises to dominance. On the other hand, because of the transfer of profits from manufacturing to sales. Product heterogeneity and experiential value are important factors that determine the realization of value. However, both the heterogeneity and the creation of experiential value can't be separated from the value added link in the downstream.

97. To change the disadvantageous position of division of labor in international competition of Liaoning's equipment manufacturing industry, we should not only emphasize the association to expand development ability in the upstream, but also need to pay attention to extension of the related link of achieving the value of innovation in the downstream, and promote the channel integration and implementation of brand strategy.

98. At present, most of Liaoning's enterprises have entered into the international market by long-term contracts with overseas distributors and retailers. As overseas distributors have a very strong market power, local enterprises are often in the "capture governance model", which is easy to lose the ability to bargain. Therefore, for the Liaoning's equipment manufacturing industry, it is a feasible mode for the core enterprises to implement vertical integration of the international market through the form of property rights integration. Specifically, the following three modes can be adopted:

99. Firstly, enterprises with overseas operating capacity can build their own global marketing channels to expand downstream of the global value chain. Liaoning enterprises should make full use of the resources network of overseas Chinese businessmen, establish overseas sales outlets in the form of equity cooperation, or attract overseas Chinese to join in, and jointly operate the overseas chain management system.

100. Secondly, combine the advantages of Liaoning's equipment manufacturing and the advantages of overseas companies' channels to jointly develop the international market by establishing joint ventures with foreign companies. For example, Northeast Power Transmission and Transformation Machinery Manufacturing Co., Ltd. carries out cooperation with international companies having rich experience including ABBM, Siemens and Alstom in the introduction of technical software of ±500KV AC and DC filter, and has absorbed ABB company's±500KV AC filter capacitor design and manufacturing technology in the Three Gorges HVDC project and achieved good development.

101. Thirdly, achieve the rapid implementation of vertical integration of overseas channels through mergers and acquisitions of overseas brands and channel operators. The acquisition of overseas brands and foreign traders with mature sales networks is an important way for enterprises to control overseas channels quickly. At present, some large enterprise groups of the equipment manufacturing industry in Liaoning have got good financial strength and rich experiences in international operations; for them, the acquisition of overseas channel resources by merger and acquisition can make the preoccupation of opportunity in international competition.

102. In addition to the integration of overseas channels and the implementation of the downstream value chain profitability enhancement, it should also focus on the implementation of brand strategy to make independent brands bigger and stronger. For a long time, many enterprises in Liaoning's equipment manufacturing industry are stronger than multinational companies in production technology level and product technology, but their brand channel operation ability is poor, and therefore they can only be engaged in OEM and get a small amount of pay for processing. Therefore, Enterprises of Liaoning's equipment manufacturing industry should focus on the following aspects in implementing the brand strategy.

103. Firstly, implement brand strategy, improve brand reputation, establish brand image and expand brand share. For example, Huawei Company has established development goals to become the mainstream of the world telecom brand manufacturers; in order to achieve this goal, Huawei has commissioned a famous global consulting firm to conduct a comprehensive assessment and planning of its brand, and has launched the "Oriental Silk Road", "Orient Express" and other brand plans.

104. Secondly, enterprises of Liaoning's equipment manufacturing industry should attach importance to the international promotion of their own brands, and break through the vicious circle of OEM. Insisting on the construction of private brand is an important way for the cluster and enterprise to enhance their competitive power in the international market and to promote the comparative advantage.

105. Finally, enterprises of Liaoning's equipment manufacturing industry should recognize the overseas brand merger and acquisition. In recent years, many Chinese enterprises have tried to break into the international market by merging the overseas brands, but basically failed. The acquisition of overseas brands has many problems, such as high operating costs, difficulties in cultural integration, obvious cultural conflicts and serious loss of resources. Therefore, for many enterprises of Liaoning's equipment manufacturing industry lack of

international experience of operation, they should be fully aware of the risks of overseas brand M&A, have a careful analysis and make detailed plans before M&A, so as to ensure the consistency of M&A with the corporate strategy and avoid blind investment and purchase.

2. Improve upstream innovation capability

106. The innovation ability is the foundation for the survival and development of enterprises in the ever-upgrading of the equipment manufacturing industry. Without the support of research and development, even if an enterprise has established a perfect marketing channel relying on individual products, it is difficult to adapt to the long-term fierce competition in the market. Upstream innovation capability is an important cornerstone for the formation of market forces of equipment manufacturing enterprises, which has an important impact on the realization of innovation value in the downstream of the value chain. The equipment manufacturing industry in Liaoning can effectively guarantee the realization of the innovation value in the downstream, enhance the channel rights and brand value and strive for market competitive advantages through the innovation in the upstream of the global value chain. Specifically, the following two aspects should be highlighted in innovation in the upstream of Liaoning's equipment manufacturing industry.

a) Integrate global scientific and technological resources to enhance technology acquisition capability.

107. In the international competition, equipment manufacturing enterprises should expand the upstream of the value chain through the integration of global R&D resources. Multinational corporations in developed countries are often occupying the R&D links to prevent technology from spreading and maintaining their market forces. Therefore, it is difficult for Liaoning's equipment manufacturing industry to obtain vertical technology spillover through participating in vertical division of labor system. The vertical integration of overseas R&D resources is an important way to expand the equipment manufacturing industry in Liaoning from manufacturing to R&D links. There are three main ways for vertical integration of overseas R&D resources:

- Firstly, the introduction of technology through technical licensing and other means.

- Secondly, creating international R&D strategic alliances, and cooperating with partners in research and development.

- Thirdly, the implementation of outward foreign direct investment aiming at technology acquisition. Due to the strict technical monopoly of multinational

corporations, it is often difficult for equipment manufacturing industry in Liaoning to adopt the first two ways to obtain advanced or core technology. Therefore, while implementing a variety of measures, it is especially important to advocate the competent industry core enterprises to implement the "technology acquisition oriented outward foreign direct investment", which is a feasible integration mode of overseas R&D resources.

108. The technology acquisition oriented outward foreign direct investment is a cross-border capital export behavior with the goal of obtaining intelligence resources, research institutions and other technical elements in host countries, by means of creating or acquiring overseas service agencies and aiming at the enhancement of the ability of enterprise's technical competitiveness and independent innovation ability. This kind of investment behavior is an effective measure for Chinese enterprises to take the initiative to cut into the high end of the global value chain in the current international division of labor. The technology acquisition oriented outward foreign direct investment has the "reverse technology spillover" effect, which can improve the innovative ability and ability to bargain of enterprises, and help enterprises of Liaoning's equipment manufacturing industry to enhance market forces in the global value chain.

109. Among the enterprises of Liaoning's equipment manufacturing industry, Shenyang Machine Tools Group is a model of relying on overseas R&D resources to integrate and enhance market forces. At present, it has set up overseas R&D institutions in Sweden, Stockholm, the United States and other places, which collaborate with domestic R&D institutions and together constitute a global R&D network. Taking the R&D of Huawei NGN for example, the research institute in Dallas is mainly responsible for international cooperation, tracking the latest technical and NGN overall system analysis and design, the research institute in Bangalore is mainly responsible for protocol stack and software development for soft exchange of NGN core technologies and the domestic institutes in Shenzhen and Beijing is mainly responsible for customization design against for the operator's network features and the transition of solutions.

b) Secondly, build patent networks and create independent standards.

110. Liaoning's equipment manufacturing industry must attach great importance to the basic work of patents in order to occupy the upstream of the global value chain. Patent applications should become an important means for enterprises to protect technological achievements and maintain their dominant position, and enterprises should devote themselves to raising the amount of patent

applications, especially in raising the proportion of patent applications for inventions.

111. In recent years, enterprises of Liaoning's equipment manufacturing industry have formed a certain degree of independent standards in some key technical fields. However, these standards are still facing many obstacles to integrate into the international market. Many domestic enterprises' multi-standard competition makes the limited research and development resources of China's local enterprises scattered, resulting in duplication and waste of resources allocation. The technical and economic characteristics of the modern equipment manufacturing industry make it impossible to have all patents under a product standard only by one enterprise's own research and development. Therefore, enterprises of Liaoning's equipment manufacturing industry must strengthen cooperation and form a joint force, achieve complementary advantages through the construction of patent alliances, promote the standardization of intellectual property rights, and achieve the establishment of independent standards. Enterprises of Liaoning's equipment manufacturing industry should form "de facto standards" through the realization of large scale in the domestic market, and launch independent standards before foreign technical standards can be established in China as far as possible, so that they can have the strength and qualification to carry out related intellectual property exchange with foreign multinational companies and enhance their control of the market.

E. Accelerate development of priority areas and consolidate the foundation for international expansion

112. There are five priority subsectors of equipment manufacturing industry identified in Liaoning provincial equipment manufacturing industry: the aerospace equipment, the energy saving and new energy vehicles, the marine engineering equipment and high end ships, the intelligent manufacturing equipment, and rail transport equipment. Descriptions of them include many technical terms, only the front two subsectors will be described in the following for illustrative purpose.

1. Speed up the development of aerospace equipment

113. Promote the R&D and manufacturing of trunk and regional aircraft. Focus on promoting R&D of the whole trunk and regional aircraft assembly and key equipment manufacturing, and R&D and industrialization of the trunk and regional aircraft large structural parts manufacturing technology. Promote the construction of Q400 Final Assembly Project and Boeing Completion Center Project to be settled, promote the projects of C series to be up graded from large parts subcontract manufacturing to regional aircraft assembly, and form the

integrated industrial chain of production of parts, assembly manufacturing, development of new models, etc. Promote the R&D and production of components and related spare parts of Chinese-made ARJ21 regional aircraft and C919 large aircraft, and speed up the R&D and construction of new model aircraft manufacturing bases.

114. Promote the R&D and manufacture of general aviation aircraft. Focus on promoting the R&D and design of common aero vehicle, parts of production, assembly manufacturing, flight trials and training. Develop the supporting industry of maintenance, tourism and leisure, convention and exhibition of general aviation aircraft,, form the whole industrial chain of general aviation. Promote the construction of general aviation industrial cluster. Speed up the construction of SAC-10, Tektronix and other final assembly and test flight projects, and promote the construction of Shenyang Shenbei New Area General Aviation Airport and Liaoning United Airlines Shenyang Aircraft Manufacturing Base.

115. Promote the R&D and manufacture of aircraft engines and gas turbines. Develop aero engines suitable for large aircraft, regional aircraft, general aircraft and other models of aircraft relying on military engine technology, focus on construction of large-scale transport aircraft engine and CF34-10A engine projects, and form capabilities of high-bypass turbofan engine research and development. Promote the construction of gas turbine industry base, adhere to the pattern of simultaneous development of both the light and heavy industry in serialization and echelon, aim to increase efficiency and reduce emissions, break through the core aspects, expand the application areas and speed up the gas turbine market applications and industrialization.

116. Promote the R&D and manufacturing of aviation spare parts and related equipment. Promote the R&D and production of components and related spare parts of Chinese-made ARJ21 regional aircraft and C919 large aircraft. Expand the scale of production of subcontracting parts for Boeing, Airbus, Bombardier, GE, Rolls Royce and other aviation manufacturing enterprises by undertaking international and domestic aviation manufacturing outsourcing, and integrate into the international aviation manufacturing industry chain. Speed up the dual-use air core key products supporting capacity building, and improve the ability of aircraft parts transformation from peacetime to wartime. Focus on enhancing the development and supporting capabilities of core equipment such as avionics, communications and navigation systems and drive the development of related industries in the Province.

117. Strengthen the development and application of space technology. Integrate the satellite system resources including Beidou navigation and Mapping Satellite

remote sensing, develop satellite data applications, integrate the technological achievements into the new-generation information industry and build a long-term and sustainable spatial and temporal information cloud computing, cloud storage and cloud application system by relying on the Shenbei New Area National Navigation and Location Service Industrial Park and Northeastern University Supercomputing Center. Start the sea-based mobile space launch platform demonstration, testing and construction project by relying on the technical advantages of marine engineering equipment manufacturing in Dalian.

2. Speed up the development of energy-saving and new energy vehicles

118. Cultivate leading enterprises actively. Focus on transformation and expansion of the existing automobile enterprises, enhance the production capacity of new energy vehicles, and make appropriate control of new projects of new energy vehicle enterprises to prevent low-level investment and redundant construction. Actively promote the large-scale production of EV batteries and other core components, speed up the cultivation and development of leading enterprises with continuous innovation capability of EV batteries, drive motors, efficient transmission and vehicle control systems.

119. Promote enterprise collaboration and supplementing. Promote the construction of new energy automotive industry alliance, adhere to the principle of being government-guided, enterprise-based, voluntary participation and mutual cooperation, strengthen the industrial chain supporting and cooperation, give full play to the advantages of each enterprise, and enhance the overall strength of the industry chain by integration. Determine the goal and direction of industrial development through the industry alliance, guide enterprises to carry out cooperative research, develop technical standards, build and share common infrastructure of research, production and testing, carry out demonstration applications, and expand the market cooperatively.

120. Enhance the level of core components. Speed up the technological innovation of EV batteries, drive motors, battery control systems and vehicle control systems and industrialization of high-tech achievements, and improve the safety, reliability and stability of core components. Promote the industrialization of new materials, structures and technologies for high-energy-density EV batteries. Support the R&D and industrialization of the drive motor system and core materials, new energy vehicle powertrain control system, body bus control system and vehicle control system.

121. Speed up the pace of popularization and application. Actively guide and promote the popularization and application of new energy vehicles including battery electric vehicles, plug-in (including extended-range) hybrid vehicles and

fuel cell electric vehicles. Give priority to the popularization and application of new energy vehicles in the urban transport system, taxi and urban logistics, encourage the use of new energy vehicles as postal services, sanitation, law enforcement and other special service vehicles, and promote the moderately advanced construction of infrastructure for EV charging.

122.

VI. Recommendations of Supporting Policies for International Expansion of the Equipment Manufacturing Industry of Liaoning

A. Changing outdated concepts, deepening the process reform and opening

123. It is necessary to change the outdated concepts in the first. The crucial area of international expansion of Liaoning's equipment manufacturing industry is to push forward continuously the liberalization of concepts, abolish the consciousness of "Officialdom Standard" and governmental intervention of the economy decisively. Establish the concepts of focusing on the perfection of China's market economy, opening to outside world and reform. It is necessary to follow the rules of market economy, put importance of institutional constrains and establishment of legalization, and actively perfect the institution and mechanism of marketization. The second, it is necessary to deepen the reform and opening. Continuously reduce the dominant influence of state owned large equipment manufacturing enterprises, encourage private capital to enter into the area of general equipment manufacturing and become the supporting enterprises of manufacturing enterprise to match the manufacturer of large scale main machinery actively. Strengthen the reform of cooperative mechanism among enterprises based on the principle of division of industrial chain and competitiveness in complement, abolish property right blockade and protection among enterprise. Accelerate the perfection of modern enterprise system, deepening the internal reform of equipment manufacturing enterprises, establish effective incentive and supervisory mechanism, innovate management mode, optimize organizational structure. Actively pursue the mutual interaction with Beijing, Tianjin, Hebei province, Russia, Mongolia, South Korea and Japan, increase the opening to outside world, actively induce the flow of factors of production such as capital, technology and talented people outside of Liaoning province.

B. Enhance organization and leadership

124. Organization and leadership are the crucial factors to accelerate the steps of international expansion of Liaoning provincial equipment manufacturing industry. The CCP Provincial Party Committee of Liaoning province and Provincial Government should master closely the opportunity of "The Belt and Road" to organize a leading group of development of internationalization. This group should cover the Provincial Development and Reform Commission,

Department of Foreign Trade and Economic Co-operation, Economic and Information Commission, Reform Commission, Bureau of Public Finance, Financial Office, State Capital Committee, Bureau of Industry and Commerce, Custom and the Bureau of the Entry Inspection and Quarantine etc. This leading group should co-ordinate the organization to prepare the development planning of international expansion of high end equipment manufacturing industry of Liaoning province, make support policies, establish date base of key enterprises and projects of international production of Liaoning's high end equipment manufacturing industry, clarify key points and key regions of international expansion of high end equipment manufacturing industry based upon overall deployment of international expansion of the central authority, Guiding directory of countries and industries for China's FDI, industrial policy of overseas investment and developing reality of high end manufacturing industry of Liaoning province. This group should also do a good job in the assessment of environment of overseas investment, guide enterprises to avoid risks and coordinate the solution of relevant problems.

C. Building information platform

125. Liaoning province should keep close ties with state related ministries and commissions and Chinese embassies and consulates abroad to acquire relevant information of latest policies and projects of international development of the state on the one side, and also the related information of targeting country of investment to support the source of projects and political security in the implementation of the international expansion for provincial high end equipment manufacturing enterprise. Through the events of the visit of leaders to abroad, and opening of international economic and trade forum, extends continuously the network of governmental service, upgrades the governmental capacity of collection of information of laws, regulations and policies of targeting countries and regions of development of internationalization; on the other side, it is necessary to integrate various resources of information, establish platform of public service of development of internationalization. Strengthen the studies of legal system, regulations and policies of targeting Countries in the processes of international expansion of Liaoning province. Develop forecasting of the market, to supply information of reliable and authoritative market demand, investment environment and laws and regulations for provincial enterprises carrying out development of internationalization. Enhance matching support service of asset evaluation, law, accounting and evaluation of investment risks; establish foreign intermediary system with features of marketization, socialization and internationalization. Guide the enterprises to utilize arbitration and other non-litigation means to deal with dispute over transnational investment.

D. Implementation of fiscal, taxing and financial support policy

126. First, it is necessary to strengthen the supporting strength of public finance and taxation. Study to create special funds for international expansion of high end equipment manufacturing industry of Liaoning province, to give appropriate subsides to those construct projects of public service guarantee system which are favorable to the promotion of international expansion of high end equipment manufacturing industry, to support important projects of high end equipment manufacturing industry of international expansion by means of interest and guarantee subsidies. The second, it is necessary to expend the financing channels. Establish investment fund of high end equipment manufacturing industry of Liaoning province. This fund will support overseas investment of Liaoning provincial dominant high end equipment manufacturing enterprises, by attracting shares of social capital and taking of equity investment, utilize the leverage of the fund to prize the private capital. The third, implement the financial support policies. Encourage the development of financial leasing and financial leasing companies, assist provincial high end manufacturing enterprises to expand the scale of policy based loans, promote syndicate loan, export credit and project financing. Apply for the national foreign and preferential loans and preferential export buyer's credit. In order to provide long term low cost foreign exchange loan for implementation of high end equipment manufacturing enterprises of development of internationalization, financing service platform of Silk Road Fund, China Africa Fund, ASEAN Fund etc. should be well utilized. Lastly, there is need to strengthen the export credit guarantee service. Implement subsidiary policy of export credit guarantee and insurance premium for enterprise carrying out development of internationalization, and coordinate China's Export and Credit Insurance Corporations to prolong the period of underwriting, and expand coverage of insurance.

E. Cultivating talents for International expansion

127. Talents are important guarantee to carry out international expansion smoothly. Liaoning province should set up training classes for all kinds of personnel in a planned way. Proceed systematic training of insurance, credit and other knowledge relate to international expansion of high end equipment manufacturing industry. Create a team of transnational management interdisciplinary talents with the ability of development of international market, these talents should understand rules of international economic operation well, and they should also be familiar with local laws and regulations.

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