

# 中国和韩国风电发展潜在合作机会分析

## Analyzing Potential Cooperation Opportunities for Sino-Korean Wind Power Development

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### Foreword

The potential cooperation opportunity available for the development of Sino-Korean wind power enterprises (WPEs) should be studied based on the comparison and analysis of their competitive advantages. As a basic form of analysis of potential cooperation opportunities, the results of the evaluation of the competitive advantages of the Sino-Korean WPEs were obtained in terms of the following two aspects. First, the results of the integrated evaluation reveal that WPEs such as China's Goldwind<sup>1</sup>, Sinovel<sup>2</sup>, DEC<sup>3</sup>, and XEMC<sup>4</sup> as well as Korea's Unison<sup>5</sup> and Hanjin<sup>6</sup> have superior competitive advantages over their competitors. These advantages are in terms of stronger financial strength and background resources accumulated over a long period of development, superior capability of R&D and local production for the megawatt (MW)-scale wind turbine generator systems (WTGs) and their better development achievements in wind farms, and a larger perspective of development. Second, the preliminary conclusions of the study mentioned above show that the potential cooperation opportunities for the development of Korea's WPEs in China's wind power market exist due to the competitive advantages that Korea's WPEs have in comparison to those of China. Based on this preliminary conclusion, this paper will make a further study to continually seek and explore the potential cooperation opportunities available between the Chinese and Korean WPEs.

The analysis of the potential cooperation opportunities for the development of Sino-Korean WPEs is based on finding the combination point in the following four aspects: (1) to seek the reciprocal point between inadequate supply of manufacturing WTGs in China and the demand of expanding WTGs' technology by Korean enterprises; (2) to analyze the probability between the previous point and the Korean WPEs' desire to develop in China's wind power market and whether their technologies, products, or services are accepted by the Chinese market; (3) to find mutual benefit between the disadvantages of Chinese enterprises and the advantages of Korean enterprises; and (4) to pay attention to offshore wind power, which, as a new wind power market, could acquire potential cooperation opportunities from joint R&D by Chinese and Korean WPEs. The study should be carried out by focusing on

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<sup>1</sup> Goldwind Science & Technology Co., Ltd.

<sup>2</sup> Sinovel Wind Co. Ltd.

<sup>3</sup> Dongfang Electric Corporation

<sup>4</sup> Hunan Hara XEMC Windpower Co., Ltd.

<sup>5</sup> Unison Co., Ltd

<sup>6</sup> Han Jin Ind. Co., Ltd.

the key issue of how to identify and understand the opportunities and challenges faced by Korean enterprises, when they wish to utilize their own technology advantages for development in the Chinese wind power market. It is also important for the analysis to focus on the environmental policies in China's wind power market and the development stratagem of Chinese WPEs.

### **Analyzing the Key Factors**

There exist potential cooperation opportunities for Korea's enterprises to develop wind power in China's wind power market. The main reasons for this can be viewed from the following two sides. One side concerns Korea, whose wind power market is small in the onshore areas because people do not accept the visual impact of wind power. Therefore, the technology advantages of Korean wind power have to be developed toward the offshore wind power in Korea or in overseas regions. On the other hand, Korean enterprises have the potential to develop wind power in China's wind power market in the future. The conclusions on the evaluation of the competitive advantages among the Sino-Korean WPEs show that the competitive advantages of major Korean WPEs are on the same level as the first-class Chinese WPEs. In some aspects, the competition advantages of Korean Unison are slightly better than those of the first-class Chinese enterprises; particularly in terms of local production, the larger capacity WTGs (2 MW and above) and the key component parts of WTGs gained more authentications. Other Korean enterprises such as Hanjin, Hyohung, Doosan Heavy Industries, STX Engine, Dongkuk S&C and Dongkuk Industries, Hyosung, and Kowintec also have better capabilities with R&D 2–3 MW WTGs. With regard to offshore wind power development in Korea, the design prototype of 3 MW offshore WTGs has been continually used since 2004. A demonstration research project on 2 MW WTGs for offshore wind power was launched in 2005. At present, two sets of 2 MW WTGs have been installed in Jeju Island. The abovementioned evolution of Korea's offshore wind power shows that Korean WPEs have made some progress. Therefore, the study considers that Korean enterprises have the basic potential for future development in China's wind power market. The other side pertains to China, which has a huge wind power market. However, owing to a large market demand, the supply capability is much lower for developing wind farm and manufacturing WTGs. The wind power industry in China continues to stand at the initial stage of industrialization. The technologies used in the manufacturing of WTGs and the key component parts have changed from reliance on foreign technologies to independent development by local manufacturers. With the exception of certain enterprises (Goldwind, Sinovel, DEC, etc.), which have mature technology owing to their longer development period of wind power, the other enterprises are mostly newer entrants that still require time to achieve their best production capacity.

Based on a synthetic consideration of the abovementioned factors, the study holds that interdependent relations exist in the field of Sino-Korean wind power development, where the market demands of China are combined with the expanding technology of Korea. The potential cooperation opportunities will be further analyzed in detail.

## **Analyzing Potential Business Opportunities in China's Wind Power Market**

### ***Business Opportunities in R&D MW-Scale WTGs***

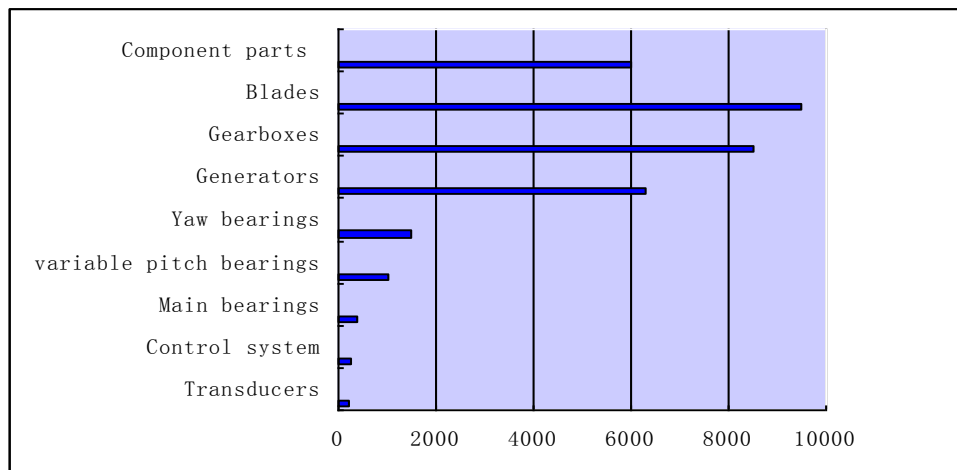
At present, it is necessary to enhance the technological level of the R&D MW-scale WTGs in China's domestic enterprises because a batch production of MW-scale WTGs implies that only some general component parts of the local production are used instead of foreign WTGs. In the joint venture enterprises that manufacture MW-sized WTGs in China, foreign experts act as the chief designers, while local experts are merely students who learn and gather experience in the R&D process. Some Chinese enterprises attempted to independently manufacture R&D WTGs; however, they are facing a series of challenges including weak research base, little experience, shortage of researchers, and low capability of technology innovation. This situation explains that the technological capability of Chinese enterprises for developing R&D MW-scale WTGs is weak. Therefore, there is an urgent demand for Chinese enterprises to introduce and learn advanced technologies from first-class global wind power manufacturers in order to strengthen their independent R&D capabilities.

What steps can be taken by Korean enterprises as they are faced by this demand? The study suggests some responses. Korean wind power manufactures have lesser experience in developing wind power in China, and their competitive capability of R&D WTGs is far from that of the first-class global WPEs. Therefore, in recent times, it is very difficult for China's WPEs to accept the Korean-manufactured R&D MW-sized WTGs. However, considering that the competition advantages of Korean enterprises are slightly higher than those of the first-class Chinese enterprises in certain aspects, the former possess the basic potential to develop wind power in terms of R&D MW-scale WTGs in China's market in the coming few years.

### **Business Opportunities in the Manufacturing of Key Component Parts**

Chinese enterprises that produce a complete set of WTGs require sufficient supply of component parts, as there is an inconsistency between the production capacity of a complete set of WTGs and its component parts in China's wind power market in recent years and that of the future years. The production capacity of the component parts fails to meet the demand of the production of a complete set of WTGs, thus leading to its restricted production. The estimated data of the amount of planned production capacity in 2008 from major Chinese manufacturers shows that the annual production capacity of blades, generators, and main gearboxes are approximately 6000–9000 MW in 2008. However, the annual production capacity of the key component parts such as control system, precision bearing including variable pitch yaw bearings, main bearings, transducers, etc. is very small and far from meeting the other component parts of WTGs in terms of consistent production (see figure 1). Therefore, the enterprises producing complete sets of WTGs have to import a considerable amount of key components parts.

【Figure 1】 Planned Production Capacity of Major Chinese Enterprises in 2008 (MW)



Source: CRED of ERI editing according to production planning from some enterprises

Hence, there are many business opportunities in the market of key component parts of WTGs in China due to the weak manufacturing capabilities of Chinese enterprises. Many foreign enterprises come to China and build factories catering to the Chinese market's various demands related to the supplying of component parts of WTGs in China. The Rexroth Bosch Group built a manufacturing factory in Beijing to produce main gearbox and liquid pressure variable pitch yaw system for MW-scale WTGs; these products will be provided to the market next year (2009). The PPG Industry Group, a glass fiber supplier who is a global leader in technological advancement, built a factory in the Zibo city of Shandong province, with an annual production capacity of 60,000 tons. Its product, a kind of raw material used for producing the blade of WTGs, will meet the demand for the production of this blade in the markets of China and the Asia-Pacific region. SKF Group, FAG Bearing, and Timken Company—three major global bearing manufacturers—built joint venture companies with the local enterprises to develop the component parts market in China. An increasing number of global WPEs build factories in China due to the policy and regulation on the localization rate of wind power equipment. According to this regulation, many foreign products and equipments of WTGs are required to be produced in the local regions of China.

Since Korean enterprises are provided with business opportunities in the component parts market in China, the study thinks that they should become forthgoers in manufacturing component parts to secure the available business opportunities.

### **Business Opportunities in the Field of Technology Service**

China's wind power industry requires technology service in the future, as it is essential for wind power construction and operation in China. However, there was an extreme shortage of technology service until now. Since most WTGs are imported or produced by joint venture companies in China, and foreign companies protect the intelligence rights for their products, this situation leads to large amounts of maintenance costs incurred on repairing WTGs during the period of wind power operation. The cost of maintenance is higher in the later guarantee period. The statistical data from relational organization shows that the destroyed rate of the imported gearbox was 15% of the total amount. For replacing the gearbox, the

enterprise not only needs to incur a higher payment but also has to bear the loss of power generation during a longer maintenance period. The other case is about 51 sets of imported 500 kW WTGs installed in the second wind farm of Dabancheng in Xinjiang province. Due to malfunction, these WTGs did not generate electricity for more than four years because of the rather high maintenance cost. After the guarantee period, the maintenance cost is very high, including personnel service cost which amounts to about 10000 yuan RMB per day, overseas transport cost, and the equipment cost. Particularly, component parts are not supplied in time, thus interrupting the production process for a long period. The blade of WTGs also forms a main part of the maintenance, but its significance is not clearly understood by the Chinese wind power industry, leading to a lack of effective institution guarantee. The cost of the blade accounts for 25% of the total investment in WTGs; however, its maintenance and repair does not entail a guarantee of regulations. China's market faces a shortage of professional blade repairing companies. Foreign countries have institutions that look after the maintenance and examination of blades in poor wind season. Many countries made compulsory the maintenance and check-up of each blade in the poor wind season in order to reduce the maintenance cost, because the cost of repairing blade under shut down is much higher than the annual cost of maintenance and check-up.

Korean enterprises possess superior competitive advantages in terms of their background resources including outstanding capability on manufacturing of large size equipment, higher reputation on product quality, and possession of an excellent management institution and professionals. If Korean enterprises can explore and advance the field of technology service for WTGs, many potential cooperation opportunities can be obtained in this field.

### **Business Opportunities in the Offshore Wind Power Market**

A considerable amount of technology demand for developing offshore wind power in China is concentrated on the prophase work in recent years. The Chinese offshore wind power development is at the primary exploratory stage. The lack of experience is evident in a number of aspects including the R&D special wind turbine used in offshore areas, detail resource investigation, design and construction of the base parts in offing, equipments transportation, transporting and distributing system of electricity power, and safety operation. The Chinese offshore wind power is a new market that is equipped with a good development foreground. There are broad development spaces between Chinese and Korean WPEs in this new market. China has a long coast and an abundant resource of offshore wind. The wind energy resource is about 100 gillion watt in the 10-meter-deep water in the near sea and about 490 gillion watt in the 30-meter-deep water in the near sea. There are huge potential resources for developing offshore wind power in China.

China has launched the action plan for the development of offshore wind power. The project, whereby 20 MW of offshore wind farm was constructed in 2004–2006, has been approved by the government with a total investment of 240 million yuan RMB by the Guangdong Nanao Company. The management committee of the Huanghua developing areas of Hebei province has signed the agreement with Guohua Energy Investment Co. Ltd. for jointly constructing a large-sized offshore wind farm, for which the total amount of installed capacity is to reach 1000 MW. A large-sized offshore wind farm has been prepared for construction in Shanghai since 2005. The total amount of installed capacity is 3 MW, and the starting date of this project was

decided in the past five years. The China Three Gorges Project Corporation has signed “The agreement on prophase working for developing wind farm” with the Government of Cixi City of Zhejiang province. Prior to this agreement, the relational government had approved an offshore wind power project having an installed capacity of 200 MW in Yan Lake City in Jiangsu province, wherein the wind farm was to be built in the offshore area with a water depth of about 5–20 meters. This project will serve as a demonstration project for developing offshore wind power during the 11<sup>th</sup> Five Year Plan. The first project of offshore wind power, developed by CNOOC Limited (China National Offshore Oil Corp.) was put into production in 2005. The WTG, which is a 1.5 MW capacity direct driven permanent magnet WTG, was installed at No. 36-1 oil field in Suizhong, which is 70 kilometers away from the coast and 30 meters deep in water.

The Korean government also began to plan the development of offshore wind power. Unison planed to finish the conceptual design of a 3 MW offshore wind turbine from September 2004 to May 2006. Some enterprises are also researching and developing special offshore wind turbines. Since Korea is a mountainous region, wind power was restricted in the inland. Therefore, it is more important and stringent for Korea to require R&D offshore wind power technology and to develop the offshore wind farm. Thus, the study thinks that Korea should launch a large number of investments in order to concentrate on R&D offshore wind power and achieve a technological breakthrough.

The abovementioned discussion shows that Sino-Korean enterprises have potential cooperation opportunities for the development of offshore wind power.

## **Suggestions**

Based on the evaluation of the competitive advantages of Sino-Korean WPEs and the analysis of their potential cooperation opportunities in China’s wind power market, the study puts forward some proposals for promoting cooperation.

### **Accumulating Stronger Advantage for Technological Breakthrough of 2—3 MW-Scale WTGs**

Korean enterprises possess technological advantages and professional skills for the local manufacturing of MW-scale WTGs. The study proposes that Korean enterprises and institutes should put developing wind power technology as major objects of strategy and focus on existing technological breakthrough in the field of independent R&D and local manufacturing of 2–3 MW-scale WTGs in the coming few years. Korean enterprises need to strive hard to make greater progress for manufacturing larger capacity MW WTGs so that they can be globally advanced, and to accumulate stronger advantages for obtaining development opportunities in China’s wind power market. The potential cooperation opportunities are estimated in terms of joint designing and manufacturing 2–3 MW or larger WTGs, technology consultation for manufacturing technology, and technology training for professional talents.

In terms of reaching a technological breakthrough for R&D and manufacturing WTGs, the experience gathered from Guangdong Mingyang Wind Power Technology Co. Ltd. (Mingyang) is a good case of referral for Korean enterprises. Mingyang, which, as a subsidiary company of Guangdong Mingyang Electric Group Co., Ltd., has signed a deal to sell WTGs with a capacity of 108 MW to Wind Hunter LLC, a wholly-owned unit of US-based Green Hunter Energy Inc. in 2008. The shipment of the MW-scale

WTGs to the United States is a first time experience for a Chinese company. Mingyang developed the first anti-typhoon 1.5 MW WTG with independent intellectual property rights in China in 2007; this WTG has safely operated for several months since it started running in the wind farm of Yuedian Zhanjiang Xuwen on September 2007. It has also passed the authentication of Germanischer Lloyd—an organization that ensures technical safety. So far, the 1.5 MW WTG models have been put into batch production. By the end of November 2007, Mingyang received orders for 400 sets of WTGs with a total capacity of 600 MW (<http://www.reliableplant.com>). It was only within a period of three years from the registration of its company that Mingyang exported 1.5 MW WTGs to the United States for the first time. Their experience shows the successful and rapid technological enhancement of R&D WTGs by combining joint design with independent innovation. Mingyang's experience of development is summarized as follows: joint development and designing of R&D 1.5 MW double-fed variable-speed and variable-pitch WTGs with Germany's Aerodyn during the starting period in 2005; utilization of the four core technologies owned by Mingyang, which gained national invention patents on the IGCT; institution of the agreement in advance for the intellectual property rights of WTGs technology, belonging to Mingyang during the joint development and design; and achievement of learning and mastering international advanced technology for designing and manufacturing WTGs. Korean and Chinese enterprises could learn a lot from Mingyang's aggressive spirit for technological innovation and the strategy of overseas expansion.

### **Exploiting New Market on Technology Services for Wind Power Industry**

Along with China's booming wind power industry, the demand from various areas including technical consulting and training for designing wind turbines, and manufacturing, installing, operating, and repairing WTGs will rapidly increase in the future; however, at present, China has a limited number of qualified special organizations that provide these demands. With an increasing number of new wind farm projects, a large amount of expertise is required for related technical consultancy and service in various stages including wind farm project preparation, wind energy resource survey, pre-construction consultancy, wind farm site selection, planning and design, construction supervision, installation engineering, operational management, monitoring, examining, and repairing etc. Therefore, it is necessary that technical consulting and training be supplied for meeting these demands of the booming wind power industry. The third industry, wind power technology consultancy and services industry, needs to be developed actively in China.

Korean WPEs have advantages and experience on local R&D MW WTGs as well as management institution and professional talents based on their background resources of large size manufacturers. Based on these advantages, Korean enterprises that are entering the field of technology services in China's wind power market will face weaker competition and have a larger developing space. The study proposes that Korean enterprises should have intelligent foresight to put technology services as an important exploitable potential cooperation opportunity in recent years. The collaboration approaches estimated are that Korean enterprises should set up a foreign company engaged in technical consultancy and services or build a joint venture company through associations with local manufacturers. Particularly, the latter form of collaboration can achieve a win-win situation. That is to say that local enterprises can gain by increasing capability and extending new business, and Korean enterprises

can possess technical service and increase the capability of overseas expansion in this cooperation. Korean enterprises that enter the Chinese wind power market in terms of technology service may not only be threatened by competition from foreign and Chinese enterprises but also, as a newcomer, accumulate experience in a weak competitive environment. As a specialized technical consultancy and service company, a systematized technology service can be adopted in various areas including technology consulting and training for preparing pre-developing project; installing and debugging in wind farm construction; maintaining and repairing in wind farm operation; controlling assembly technical quality in manufacturing process; specialized training on various aspects of design, engineering, operation management, and maintenance. In short, Korean enterprises can play an important role in the third industry of wind power technology consultancy and technical services.

The experience in development acquired from Denmark's Vestas is a good example. Vestas not only engaged in R&D WTGs and developed wind farms but also undertook the selling of wind turbines and exploited the market of the maintenance and repair of WTGs. Vestas' sub-companies had spread over fifteen countries in order to manage different kinds of wind power business.

### **Availing of Business Opportunity in Key Component Parts Market**

It is very important that Korean enterprises consider the significance of localizing the manufacturing technology required for producing key component parts of WTGs because it is an urgent requirement in Korea and China. At present, only a few enterprises are able to produce wind turbine blades, gearboxes, generators, and control systems on a large scale; further, their production capacity is not adequate for meeting the demands of China's wind power market. Due to the specialized requirements of the manufacturing of component parts, such as large fixed investments and specialized technologies, very few enterprises can enter the component parts market although the market lacks supply of component parts. In comparison, the enterprises, which manufacture key component parts, such as the electrical control devices, yawing systems, hub (with pitch-variable mechanism), tower, nacelle, main bearing, and hub cover, will face more technical difficulties than the enterprises manufacturing the blades and gearbox. Hence, there are more hindrances if enterprises want to enter the key component parts market. The study suggests that Korean enterprises should avail of the business opportunities offered in the manufacturing of key component parts of WTGs. If some Korean enterprises could utilize their competitive advantages in manufacturing WTGs in recent years, it is possible that Korean manufacturers would cooperate with local manufacturers in China through joint ventures or export their products to China's wind power market.

### **Co-research and Development for Offshore Wind Power Strategy**

The prophase work of offshore wind power development has started in China and Korea. In comparison, the Korean demand for developing offshore wind power is more emergent than China since wind power development was limited to inlands in Korea. Therefore, the study suggests that Korean governments and enterprises should sufficiently cognize the essentiality of taking possession of the offshore wind power market and placing its development at an important strategic position. Through intensifying R&D of offshore wind power, Korean enterprises have obtained technological breakthrough in recent years. The Korean and Chinese enterprises, which are developing the offshore wind farm together, are forecasted to have more

opportunities in the future. In addition to the abovementioned point, the study also proposes that some promotional activities be carried out during the prophase work of offshore wind power development, including organizing seminars to facilitate easier communication and understanding in terms of researching development strategies, organizing technicality exchange activities and interchange visitors and training, etc.

### **Focusing on Wind Power Concession Program and Other Policies**

The study proposes that Korean enterprises should pay attention to the policy adjustment of wind power concession program and tax policy on foreign capital and foreign enterprises. The wind power concession program is an important policy and measure for promoting large-scale wind power development in China at present and in the future. It is very important for Korean enterprises to understand the regulations and the operational mechanism in China's wind power market. The wind power concession program introduces investors' competition mechanism, and it states that any investor including a foreign investor is allowed to participate in public tendering for developing wind power in China. Korean enterprises have a similar experience in wind power concession, as there is a Korean wind power farm, operated by GE, according to the basic form of a build-operate-transfer (BOT) in Gangwon province of Korea. As a potential cooperation opportunity, Korean enterprises may cooperate with local enterprises in China and serve as suppliers to exercise the advantage of producing 2 MW WTGs and the component parts of WTGs in the future.

### **Strengthening Intercommunication for Accelerating Potential Cooperation**

The study suggests the strengthening of intercommunication activities for promoting cooperation in the development of wind power and renewable energy based on the Northeast Asia Energy Cooperation. Center for Energy Research International Studies (CERIS), as a window of the Northeast Asia Energy Cooperation, has maintained perfect cooperative relations in the field of energy between the two countries' governments and research institutes, and has carried out a large number of energy research. The study suggests that CERIS play an important role in continually promoting cooperation to accelerate communication and to better understand the aspects of wind power and renewable energy. A series of activities can be organized to accelerate the potential cooperation of wind power development between China and Korea, such as providing forums for intercommunication policies and regulations, setting up networks as a medium for sharing information on supply and demand between the WPEs and the market, organizing training programs, and visiting each other to gain from advanced technologies and experience.

### **Emphasis Challenges for Korean Wind Power Enterprises**

Korean WPEs will face challenges from the global WPEs monopolizing market. At present, in Chinese wind power markets, the WTGs from major global wind power manufacturers account for three-fourth of the total of WTGs. The four major wind power manufacturers are Vestas, GE Wind, Enercon, and Gamesa; they have continuously built factories in China. Denmark's Vestas, Spain's Gamesa and India's Suzlon set up manufacturing plants in Tianjin, while America's GE Wind set up manufacturing plants in Shenyang province. The production capacity of WTGs from four wind power magnates is over 3000 MW per year in China. Therefore, the monopolized wind power market by the global wind power giants in China directly threatens and restrains the development of other wind power manufactures. Sharing similar characteristics with Chinese enterprises, Korean enterprises are in a weak

position in the wind power market because of lag development leading to immature technology. Therefore, it is considerably difficult for Korean enterprises to occupy a certain position in China's wind power market. This issue should be adequately cognized by Korean enterprises.

Korean WPEs will cope with the challenges along with Chinese enterprises in China's wind power market. Faced with business opportunities in the huge wind power market and owing to the government's accelerating policy, China's wind power manufacturers have increased investments to stabilize and expand their own position in the wind power market. Except for the abovementioned status, there are more than 30 new companies all set to enter the wind power manufacturing market by way of independent R&D or joint development with a foreign company. Korean enterprises are faced with the challenges of competition in technology and contesting the market with Chinese enterprises. Therefore, Korean companies need to establish a suitable cooperation strategy for sustaining their competitive advantage.

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