

Patent Applications of Chinese Self-owned Brand Automobile Enterprises in Countries along the Belt and Road

ZHANG Feng ¹, YAN Jie ², MIAO Xiaoming ³

^{1,2,3} School of Management, Northwestern Polytechnical University,
Xi'an, Shaanxi province, China 710129

Sponsoring Information:

This study is supported by Soft Science Research Program of Shaanxi Province (No. 2013KRM41-03).

Abstract:

As “One Belt and One Road (OBOR)” strategy further develops, the international economic and technological cooperation between China and other countries along the Belt and Road enhances. Through using the data taken from Derwent Innovations Index, the trend of patent applications Chinese self-owned brand automobiles in countries along The Belt and Road is analyzed temporally and spatially. On this basis and from the analysis of technology field, it can be found that Chinese self-owned brand automobile enterprises have advantages in technology field for patent applications compared with other countries along The Belt and Road Initiative. Furthermore, the dynamic trends of the technologies and characteristics as well as the trends of technological layouts of the automobile enterprises in different countries are concluded. They provide references for further implementing the OBOR strategy among Chinese self-owned brand automobile enterprises.

Keywords: One Belt and One Road, Chinese self-owned brand automobile enterprises, patent applications, technology fields

1. Background

In September and October, 2013, Chinese President Xi Jinping successively proposed to jointly build the Silk Road Economic Belt and the 21st Century Maritime Silk Road (briefly called “One Belt and One Road (OBOR)”) while visiting central and Southeast Asian countries. The international community has highly concerned this strategy. The joint development of the OBOR strategy aims to promote the economic and policy coordination of the countries along The Belt and Road, carries out broader and deeper regional cooperation at a higher level, and jointly builds an open, inclusive and balanced regional economic cooperation structure that benefits all. The OBOR strategy is proposed in order to explore a new pattern of international cooperation under new historical background. Jointly building OBOR is the requirement for deepening China’s Opening-up policy as well as strengthening the win-win cooperation between China and different countries in the world (such as Asian, European and African countries). With the further promotion of the OBOR strategy, the international cooperation among the countries along The Belt and Road enhances^[1]. As the military strategy requires that supply should go ahead, and all countries participating in the international cooperation of OBOR should have the awareness of putting priority on intellectual property^[2]. Patent, as a main approach of an enterprise to utilize the intellectual property, always plays an extremely important role in international cooperation, which can convoy the internationalization development of enterprises^[3-4].

China’s sales volume for automobiles has continuously ranked first over the past years. China has become an influential country in automobiles. Due to China’s accumulative experience, automobile manufacture enterprises all target the overseas markets. The OBOR strategy involves about 60 countries, most of which are in the ascending phase of economic development, massive development potential in automobile market is shown. Therefore, the self-owned brand automobile enterprises in China have successively started to plan their layout along The Belt and Road. The patent applications of Chinese self-owned brand automobiles in countries along The Belt and Road is an important expression in patent layout, which reflects their technological innovation progress of automobiles. Trough analyzing the patent applications of Chinese self-owned brand automobiles in the countries along The Belt and Road, the innovation progress, technological advantages and disadvantages of these enterprises in OBOR construction are obtained. Furthermore, the automobile enterprises can carry out international cooperation to make full use of their advantages and achieve win-win cooperation by linking import-export trades.

A statistical analysis was made for total quantity of patent and patent applications of Chinese self-owned brand automobile enterprises in foreign countries. On this basis, the study concentrated on the patents of five self-owned brand automobile enterprises of China applied in the countries along The Belt and Road. According to the corresponding relations of the patentee codes, country codes for patent numbers, and international patent classification (IPC) in Derwent innovations index with technology fields, the technology fields are studied in depth. The technology fields of patents applied by the five self-owned brand automobile enterprises of China in the countries along The Belt and Road are linked with their foreign trades^[5]. It can provide references for further implementing the OBOR strategy.

2. Chinese self-owned brand automobiles exported to countries along the Belt and Road as well as their patents

China Association of Automobile Manufacturers (CAAW) made a statistical analysis on automobile exports in the countries along the Belt and Road based on data provided by China Customs. According to statistics, the total amount of automobile commodities and the export volume of finished automobiles of China to the countries along the Belt and Road both rapidly increased in March, 2017 and the growth rate was slightly higher than that of the whole industry. The automobile commodities of China exported to countries along the Belt and Road valued 2.348×10^9 dollars, manifesting a month-on-month growth rate of 52.82% and a year-on-year growth rate of 15.76%, which took up 35.38% of the gross export of all automobile commodities. In which, the exported finished automobiles reached 41,700, showing a month-on-month growth rate of 44.8% and a year-on-year growth rate of 13.9%, which accounted for 59.57% of the total exported finished automobiles.

January to March, 2017, the automobile commodities of China exported to countries along the Belt and Road cumulatively valued 6.2×10^9 dollars, with a year-on-year growth rate of 11.54% (7.91 percent higher than that of the whole industry), which accounted for 34.55% of the gross export of total automobile commodities. In which, 110,400 finished automobiles were exported, showing a year-on-year growth rate of 26.98% (3.69 percent lower than that of the whole industry), which took up 57.26% of the total exported automobiles.

Chinese self-owned brand automobile enterprises having trades with the countries along the Belt and Road are taken as objects, and the State Intellectual Property Office (SIPO) of China and Derwent innovations index are applied as the data sources. In this way, the patents of these automobile enterprises applied in China, in World Intellectual Property Organization (WIPO) and in the countries along the Belt and Road can be obtained. For example, to retrieve patents of BYD Co. Ltd. applied in the WIPO, one can use the expression of AC=BYDB-CAND PN=WO*. A comparison of patents was made between self-owned brand automobiles (including Brilliance Automotive Group Holdings Co. Ltd., BYD Co. Ltd., BaicMotor Corp. Ltd., Guangzhou Automobile Group Co. Ltd., Chery Automobile Co. Ltd., AuhuiJianghuai Automobile Group Co.Ltd., Zhejiang Geely Holding Group Co. Ltd., and Chongqing Chang'an Automobile Co. Ltd.) in the countries along the Belt and Road applied in China and across the world, as shown in Table1.

Table 1 Comparison of patents of Chinese self-owned brand automobiles applied in China and in other organization and countries

Self-owned brand automobile enterprises	China patent	Derwent patent	WIPO patent	Patent applied in the countries along the Belt and Road
BYD Co. Ltd.	17809	11941	837	26
Chery Automobile Co. Ltd.	12996	10588	139	6
Zhejiang Geely Holding Group Co. Ltd.	15325	11579	166	3
Brilliance Automotive Group Holdings Co. Ltd.	1579	983	0	0
Chongqing Chang'an Automobile Co. Ltd.	9468	5015	36	4
Anhui Jianghuai Automobile Group Co. Ltd.	2928	1166	37	7
Guangzhou Automobile Group Co. Ltd.	2489	1466	6	0
Baic Motor Corp. Ltd.	4719	1085	1	0

As shown in Table 1, some Chinese self-owned brand automobile enterprises exporting to countries along the Belt and Road (such as Brilliance Automotive Group Holdings Co. Ltd., Baic Motor Corp. Ltd., and Guangzhou Automobile Group Co. Ltd.) have no patents applied in foreign countries and therefore they are not taken as research objects. The study mainly investigated Chinese self-owned brand automobile enterprises exporting to countries along the Belt and Road which also have patents applied in WIPO and especially in the countries along the Belt and Road.

By analyzing literatures and conducting the group discussion, five Chinese self-owned brand automobile enterprises, involving BYD Co. Ltd., Chery Automobile Co. Ltd., Zhejiang Geely Holding Group Co. Ltd., Anhui Jianghuai Automobile Group Co. Ltd. and Chongqing Chang'an Automobile Co. Ltd., were taken as research objects to analyze their patents applied in the countries along the Belt and Road. The retrieval expressions of patents of the five automobile enterprises applied in various countries in six areas along the Belt and Road are displayed as follows: for example, when searching the patents of the five automobile enterprises applied in Mongolia and the ten countries in ASEAN Free Trade Area (AFTA), the expressions are shown as follows:

AC=(GEEL-C OR BYDB-C OR CHRA-C OR JIAN-C OR CHON-C) AND PN=(MN* OR SG* OR MY* OR ID* OR BU* OR TH* OR LA* OR KH* OR VN* OR BN* OR PH*).

3. Temporal and spatial trends of patent applications of these automobile enterprises in the countries along the Belt and Road

There are 64 countries involved in the OBOR initiative, which can be divided into six areas involving Mongolia and Russia, eight nations in South Asia, eleven nations in Southeast Asia, five Central Asian countries, sixteen Central and Eastern European countries (CEC16), other six countries of Commonwealth of Self-owned States (CIS), and sixteen countries in West Asia and North Africa. According to the patent data of these five automobile enterprises from Derwent innovations index, the study conducts analysis on the temporal and spatial trends of the patent applications of the automobile enterprises in the countries along the Belt and Road.

3.1 Temporal trend

According to the data, these five Chinese self-owned brand automobile enterprises applied 46 patents in the countries along the Belt and Road from 2007 to 2016. The annually statistical data of the five automobile enterprises is displayed in Figure 1.

On the whole, the number of patent applied by these five automobile enterprises in the countries along the Belt and Road has increased since 2007. In terms of growth rate, the patent applications of these five automobile enterprises in the countries along the Belt and Road showed the largest growth rate from 2008 to 2013 and also the growth rate after 2011 was larger than that before 2011. So, it can be speculated that the proposal of the OBOR initiative significantly strengthens the international technological cooperation of Chinese automobile enterprises.

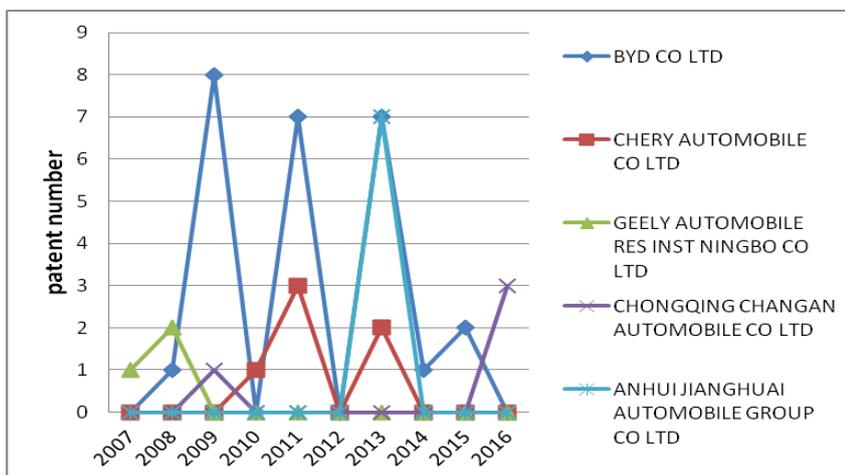


Figure 1 The patent applications of these five automobile enterprises in the countries along the Belt and Road

3.2 Spatial trend

The patents of these five automobile enterprises of China applied in countries along the Belt and Road were counted in different areas. On the basis, according to the subdivision standards of six areas of countries along the Belt and Road, the total patents of these five automobile enterprises applied in countries of the six areas were calculated, as shown in Figure 2.

It can be speculated from the figure that these five automobile enterprises applied more patents in CIS and those eight nations in South Asia among six areas along the Belt and Road. However, they did not apply patents in five Central Asian countries and CEC16, which implies that these five automobile enterprises has a closer technological cooperation and a more active patent layout in CIS and South Asia in terms of the technological cooperation with countries along the Belt and Road. Figure 3 displays the trend of patent applications of these five automobile enterprises in countries of six areas along the Belt and Road.

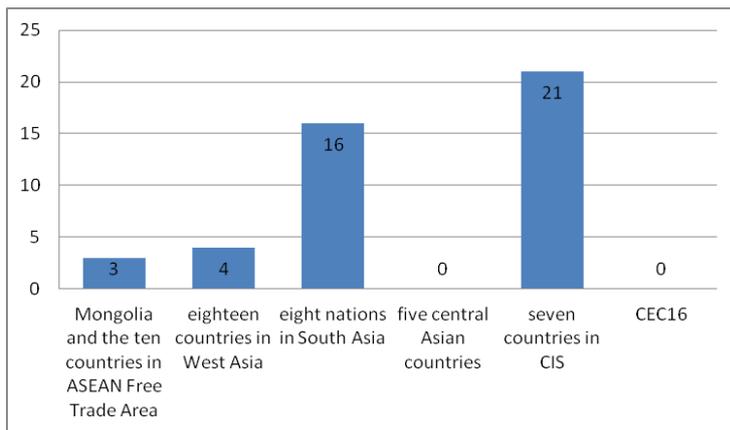


Figure 2 The quantities of patents applied by these five automobile enterprises in countries of six areas along the Belt and Road

As is shown in the trend of patent applications in Figure 3, except for the positive growth of patent applications in CIS and South Asia, these five automobile enterprises just start or intend to start their patent applications in other areas. These enterprises applied more patents in countries along the Belt and Road in 2009, 2011 and 2013.

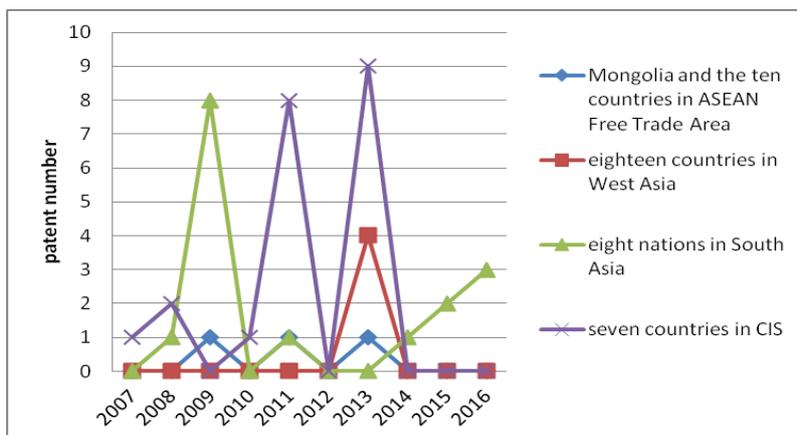


Figure 3 The trend of patent applications of these five automobile enterprises in countries of six areas along the Belt and Road

4. Major technology fields of patents of the five automobile enterprises applied in countries along the Belt and Road

According to the corresponding relationships between IPC of patents and technology fields issued by WIPO ^[6], the study analyzed the technology fields of patents of the five automobile enterprises applied in countries along the Belt and Road. By doing so, the technological advantages and disadvantages of the five automobile enterprises in these countries can be acquired in order to offer suggestions for favorably carrying out technological cooperation. In terms of technology fields, the first ten technology fields of patents of the five automobile enterprises applied in countries along the Belt and Road are displayed in Table 2.

Table 2 The first ten technology fields of patents of the five self-owned brand automobile enterprises applied in countries along the Belt and Road

Main classification codes of technology fields	Description of technology fields	Quantity of patents/pieces
H01M	Methods or devices for directly transforming chemical energy into electric energy, such as battery packs	21
B60L	Power devices of electric vehicles	15
B60K	Arranging or installing technologies of vehicle power or transmission devices; instruments or instrument boards of vehicles; arrangements relating the cooling, air intake, exhausting and fuel supply of vehicle power device;	8
H02J	Circuit devices or systems for power supply or distribution; electric storage systems	7
H01L	Semiconductor devices	7
H01H	Electric switches, relays, selectors, emergency protectors	7
H05B	Electric heating and electro illuminating technologies	7
H02M	Devices for the conversion between alternating current (AC) and AC, AC and direct current (DC) as well as DC and DC or matched devices of power supply systems	5
B60W	Joint control technologies of vehicle subsystems with different types or functions; specific control systems of hybrid power vehicles; driving control systems of road vehicles not correlated with a certain subsystem;	5
F16H	Transmission devices	5

As shown in Table 2, the first ten technology fields of patents of the five automobile enterprises applied in countries along the Belt and Road are H01M, B60L, B60K, H02J, H01L, H01H, H05B, H02M, B60W and F16H. Among them, patents relating H01M (battery) were applied at the largest frequency. B60L (power devices of electric vehicles), B60k (power devices of vehicles) and the other

seven technology fields had significant superiorities compared with technology fields of patent applications not listed in the first ten. The first ten technology fields of patents of the five automobile enterprises applied in these countries also showed the trends about technology fields of patent layouts of the six enterprises in countries along the Belt and Road: the patent applications tend to develop in emerging technology fields including electric vehicles and hybrid power vehicles.

Furthermore, the study made a time series analysis on the first ten technology fields of patents of the five automobile enterprises applied in countries along the Belt and Road, as displayed in Figure 4.

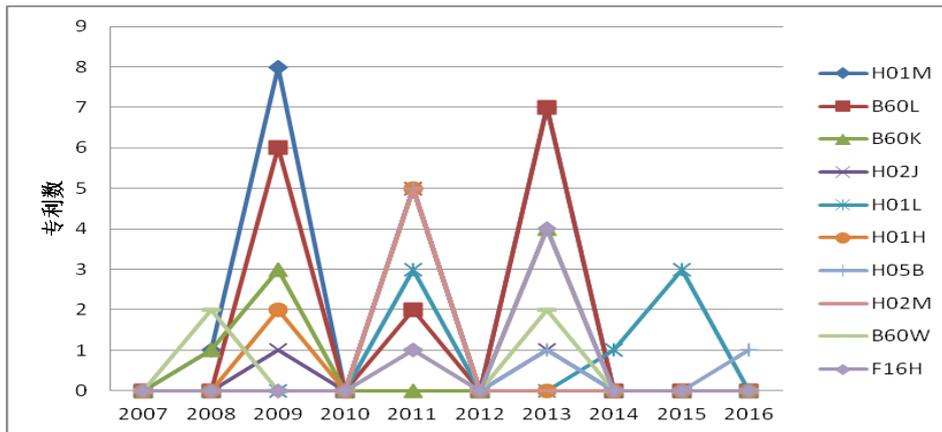


Figure 4 Trends of the first ten technology fields of patents applied by the five automobile enterprises in countries along the Belt and Road

It can be seen from Figure 4 that the first ten technology fields of patents applied by the five automobile enterprises in countries along the Belt and Road gradually rise. Among these fields, the patent applications of H01M (battery) show the most significant increase. It also indicates that with the proposal and implementation of the OBOR strategy, the international technological cooperation of these automobile enterprises also gradually changes. Especially, the enterprises exhibit the increasingly close cooperation in emerging technology fields including electric vehicles and hybrid power vehicles.

As a technology field which shows the most patents applied by the five automobile enterprises in countries along the Belt and Road, H01M (battery) generally increased in applications. Especially, there was a rapid growth in 2009 and 2013. Although it exhibited a reduction in 2010, the patent applications in the field significantly grew in 2011 and 2013, which still had superiority compared with the patent quantities in other technology fields. The trends of patents applied by these enterprises in the fields of B60L (power devices of electric vehicles), B60K (power devices of vehicles) and H02J (electric storage systems) in countries along the Belt and Road were basically the same. The patent applications in the three technology fields rapidly grew in 2009, 2011 and 2013. The patents applied by the automobile enterprises in countries along the Belt and Road maintained a positive growth rate only in the field of H01M (battery), developed from zero to eight rapidly, dropped to five and then maintained at seven.

5. Technological fields of patents applied by Chinese self-owned brand automobile enterprises in countries along the Belt and Road as well as foreign trade

The sales volume of automobiles of China has continuously ranked the first over the past eight years and therefore China has become an influential country in automobiles. By virtue of accumulative experience in China, automobile manufacture enterprises all target the overseas markets. The OBOR strategy involves about 60 countries, most of which are in the ascending phase of economic development and massive development potential in automobile market are shown. Therefore, the self-owned brand automobile enterprises in China have successively started to plan their layout along the Belt and the Road.

The OBOR strategy has initiated a broader market for the exports of China's automobiles. Except for Europe, the countries and regions along the Belt and the Road mostly appear as emerging economies where the consumption level of automobiles is at a primary stage, which conforms to the market location of China's automobile products. Faced with policy opportunities and increasingly improved logistics corridor, many self-owned brand automobile enterprises in China are actively formulating the market plans along the Belt and the Road. Xinhua News Agency reported that automobiles and their components among the first ten products of China exported to the countries along the Belt and the Road in 2016.

5.1 The first five dominant technology fields of patents applied by Chinese self-owned brand automobile enterprises in countries along the Belt and the Road

Eight Chinese self-owned brand automobiles export products to countries along the Belt and the Road contain automobile enterprises including Brilliance Automotive Group Holdings Co. Ltd. and BYD Co. Ltd. While those which apply patents mainly include BYD Co. Ltd., Chery Automobile Co. Ltd., Zhejiang Geely Holding Group Co. Ltd., Anhui Jianghuai Automobile Group Co. Ltd., and Chongqing Chang'an Automobile Co. Ltd. It implies that the five automobile enterprises are the most active in patent layout in countries along the Belt and the Road and have a close technological cooperation with these countries.

Based on the dominant technology fields of patents applied by the automobile enterprises in countries along the Belt and the Road, it can be obtained to learn the trends of technology fields of the five automobile enterprises further in patent layout in countries along the Belt and the Road. The details are shown in Table 3.

Table 3 Dominant technology fields of patents applied by Chinese self-owned brand automobile enterprises in countries along the Belt and the Road

China Self-owned brand automobile enterprises	Main classification codes	Major technology fields
BYD Co. Ltd.	H01M	Methods or devices for directly transforming chemical energy into electric energy, such as battery packs
	B60L	Power devices of electric vehicles
	H02J	Circuit devices or systems for power supply or distribution; electric storage systems
	H01H	Electric switches, relays, selectors, emergency protectors
	B60K	Arranging or installing technologies of vehicle power or transmission devices; instruments or instrument boards of vehicles; arrangements relating the cooling, air intake, exhausting, and fuel supply of vehicle power devices;
	H05B	Electric heating and electro illuminating technologies
Chery Automobile Co. Ltd.	F16H	Transmission devices
	B62D	Motor vehicles; trailers
Auhui Jianghuai Automobile Group Co. Ltd.	F02F	Cylinders, pistons or crankcases of combustion engines; sealing devices of combustion engines;
	F02M	Supply or components of combustible mixture for common combustion engines
Zhejiang Geely Automobile Co. Ltd.	G06F	Electronic data processing
	B60W	Specific control systems of hybrid power vehicles and driving control systems of road vehicles not correlated with a certain subsystem
	H02K	Motors
	H02P	Control or regulation of electric motors, generators or mechano-electronic transducers
	F02D	Control over combustion engines
	G01M	Testing of the static or dynamic balance of machines or structural parts
Chongqing Chang'an Automobile Co. Ltd.	H04B	Telecommunication transmission

By analyzing the patents of the five automobile enterprises applied in countries along the Belt and the Road, it can be seen that the five automobile enterprises have different dominant technology fields. BYD Co. Ltd. is the enterprise applying the most patents in these countries in which the technologies related to the electric vehicles constitute the main part. It is followed by Zhejiang Geely

Automobile Co. Ltd. which also shows wide patent technology fields referring to technologies of oil-powered automobiles and new energy automobiles (hybrid power automobiles), showing an advanced vehicle control technology. The patents applied by Chery Automobile Co. Ltd. and Anhui Jianghuai Automobile Group Co. Ltd. in these countries indicate that they have superiorities in engines. Chongqing Chang'an Automobile Co. Ltd. exhibits a technological advantage in vehicle communication.

5.2 The patents of Chinese self-owned brand automobile enterprises applied in the countries along the Belt and Road and export trade

What is the relationship between the patents of Chinese self-owned brand automobile enterprises applied in countries along the Belt and Road and the export trade? According to the statistical data of CAAW on exports to countries along the Belt and Road (provided by China Customs) ^[7], the export trade of Chinese self-owned brand automobile enterprises in countries along the Belt and Road can be obtained.

In the export trade to the countries along the Belt and Road, BYD Co. Ltd. concentrates on selling electric buses, taxis, trucks, etc., while BYDe6 is considered as the main vehicle type to sell. At present, new energy automobiles produced by BYD Co. Ltd. have already been distributed in more than 200 cities in over 50 countries and regions including the United States, Japan, Britain, Brazil, the Netherlands and Australia. The patents of BYD Co. Ltd. applied in countries along the Belt and Road also focus on the field of new energy automobiles such as electric vehicles.

In the export trade to the countries along the Belt and Road, Geely Automobile Co. Ltd. exported finished automobiles and manufactured parts for assembly to more than 20 countries and regions in 2016, and it ranked the first in the exports to Saudi Arabia, Cuba and Sudan. The joint-venture plant of Geely Automobile Co. Ltd. and Belarus is about to officially put into production in 2017 whose main exported automobile type (Geely Bo Yue) has appeared as the core product of the plant. In March, 2017, the Anstey factory of London Taxi Company was built in Coventry, which was the first newly built factory in Britain specializing in producing electric vehicles and new, light-weight electric commercial vehicles. The patents of the enterprise applied in countries along the Belt and Road show that its automobiles have superiority in technology fields including vehicle engines, vehicle control and electric vehicles, showing massive technological development potential.

Anhui Jianghuai Automobile Group Co. Ltd. has established favorable cooperation with more than 130 countries in the world while exporting products to the countries along the Belt and Road. The N-series light-duty trucks of Anhui Jianghuai Automobile Group Co. Ltd. are the main vehicle types for export, which provide the solutions to powers in the whole ranges of 2.8-4.8 L for light-duty trucks. The patents of the enterprise applied in the countries along the Belt and Road imply that it has a technological advantage in the field of engines.

While exporting products to the countries along the Belt and Road, automobiles of Chery Automobile Co. Ltd. have spread to more than 80 countries and regions. Two product groups- Ariza and Tiggo SUV- have appeared as the main vehicle types for export. The patents applied by the

enterprise in the countries along the Belt and Road indicate its technology superiority in the field of drive systems.

In the export trade to the countries along the Belt and Road, Chongqing Chang'an Automobile Co. Ltd. has determined its market layout in overseas strategic bases including Russia and India and realized the localized production and marketing of main vehicle type CS35 in Russia. It has eight passenger vehicle markets (Chile, Peru, Columbia, Paraguay, Egypt, the gulf region, Algeria and Azerbaijan) and eight markets (Algeria, Egypt, Chile, Peru, Columbia, Paraguay, Vietnam and Malaysia) for commercial vehicles. The enterprise has applied a few patents in countries along the Belt and Road and focused on the technology field of vehicle communication.

6. Conclusion

At present, the patent applications of Chinese self-owned brand automobile enterprises in 64 countries of six areas along the Belt and Road show a rising trend overall. The automobile enterprises actively apply patents mainly in eight countries in South Asia and seven countries of CIS. Among Chinese self-owned brand automobiles having exports in countries along the Belt and Road, BYD Co. Ltd., Zhejiang Geely Holding Group Co. Ltd., Chery Automobile Co. Ltd., Anhui Jianghuai Automobile Group Co. Ltd. and Chongqing Chang'an Automobile Co. Ltd. show great advantages. They have appeared as the first five automobile enterprises in terms of patent applications in countries along the Belt and Road. These five automobile enterprises exhibit superiority mainly in the technology fields involving electric vehicles, engines, vehicle control and communication while applying patents. During the export trade to the countries along the Belt and Road, the export trade industry generally not completely corresponds to the technology fields with large patent applications and intellectual property advantages.

Trough analyzing the technology fields of patents of Chinese self-owned brand automobile enterprises applied in the countries along the Belt and Road, the automobile enterprises which are active in patent applications in the areas and their corresponding dominant technology fields are obtained. Moreover, dynamic trends of these enterprises in technology innovation are mastered, based on which feasible suggestions can be offered for win-win cooperation under the further implementation of the OBOR strategy. In recent years, powerful promotion of international cooperation in productivity and active extension of international markets (such as the Belt and Road) have become the main source for Chinese self-owned brand automobile enterprises to increase their exports while going global in the future.

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