



## ANALYSIS OF NATIONAL PATENT COOPERATION BETWEEN JIANGSU PROVINCE AND THE BELT AND ROAD INITIATIVE

Chen Jingjing<sup>1</sup>

<sup>1</sup> Nanjing University of Aeronautics and Astronautics, 29 General Avenue, Jiangning District, Nanjing.

### Abstract

With the further advancement of the "One Belt, One Road" strategy, patent cooperation between Jiangsu Province and countries along the route has been further strengthened. At the US Patent and Trademark Office (USTPO) and the Jiangsu Provincial Productivity Promotion Center, we searched for cooperation patents and technology alliances between China and 65 countries along the Belt and Road Initiative, and analyzed the current situation of time series distribution, spatial distribution, and main technical fields. The results show that: ① Science and technology cooperation generally maintains a growth trend, which can be divided into three stages: start-up period, volatility growth period and rapid growth period; ② the cooperation area presents an unbalanced feature, and the cooperation patents of the top five countries account for 85.06% of the total. ③ The technical fields and directions of cooperation are more focused, and the cooperation patents are concentrated in the fields of electricity, human life, and physics. ④ Technology transfer and paper cooperation are mainly distributed in West Asia, South Asia, CIS, Eastern Europe, Central and Eastern Europe, and lack of innovative cooperation with East Asia and Central Asia. The conclusions of the study can provide reference for further scientific cooperation and policy formulation in the future.

**Keywords:** One Belt and One Road; Patent Cooperation.

### 1. Introduction

In September and October 2013, President Xi Jinping made a major initiative to jointly build the "Silk Road Economic Belt" and the "21st Century Maritime Silk Road" during his visit to Central Asia and Southeast Asian countries (referred to as "One Belt and One Road"). It is highly concerned by the international community. The "One Belt and One Road" will be built to promote economic policy coordination among various countries along the route, to carry out regional cooperation at a wider, higher level and deeper level, and to jointly create an open, inclusive, balanced and inclusive regional economic cooperation framework. Actions to explore new models of international cooperation in the context of the new era. Building the "Belt and Road" is the need to deepen China's opening up to the outside world, and it is also the need to strengthen cooperation and win-win between China and Asia, Europe, Africa and the rest of the world.

With the further advancement of the "One Belt, One Road" strategy, international cooperation among countries along the route has been further strengthened. <sup>[1]</sup>In the "One Belt, One Road" international cooperation, any participating country should have the awareness of "IP first" <sup>[2]</sup>. The literature review found that the academic research on scientific and technological innovation cooperation is usually carried out by analyzing the patent application of cooperation between the two countries. As the main way for enterprises to use intellectual property

weapons, patents have always played an extremely important role in international cooperation and can protect the international development of enterprises. <sup>[3-4]</sup> Zheng Jia <sup>[5]</sup>, Liu Yun <sup>[6]</sup> and Ge Huili <sup>[7]</sup> have analyzed the patent cooperation between developed countries such as China and the United States, but no scholars have analyzed the cooperation patents between Jiangsu Province and the “Belt and Road” countries. The application for patents between Jiangsu Province and the countries along the “Belt and Road” is an important manifestation of the patent layout in Jiangsu Province, and it is a reflection of its technological innovation dynamics. It can be used to analyze the application of patents between Jiangsu Province and the countries along the “Belt and Road”. With the technological advantages and disadvantages of the countries along the “Belt and Road”, we can carry out targeted international cooperation, foster strengths and avoid weaknesses, and achieve a win-win situation.

In addition, to understand the situation of science and technology cooperation in a region, we must also grasp the situation of technology transfer in this region. Technology transfer has a typical geographical feature. It is the spatial flow and diffusion of a certain technology or knowledge. This process must be carried out in a certain area up to a larger geographical area. The regional distribution of China's science and technology resources is quite different, and the regional economic development is not balanced. Technology transfer is a weak link in the construction of China's national innovation system, and has become a major obstacle to improving the independent innovation capability of Chinese enterprises<sup>[8]</sup>. The cross-regional flow of technology has become an inevitable choice to make up for the gap in regional science and technology resources, optimize the allocation of scientific and technological resources, and promote regional coordinated development. In 2007, the Ministry of Science and Technology, the Ministry of Education, and the Chinese Academy of Sciences implemented the “National Technology Transfer Promotion Action”, which marked the official launch of the National Technology Transfer Promotion Action. In 2015, in the “Vision and Action for Promoting the Construction of the Silk Road Economic Belt and the 21st Century Maritime Silk Road” issued by the Ministry of Commerce of the People's Republic of China, special mention was made to strengthen scientific and technological cooperation, jointly build joint laboratories (research centers), and international technology transfer center, maritime cooperation center, promote the exchange of scientific and technological personnel, cooperate in carrying out major scientific and technological research, and jointly enhance the ability of scientific and technological innovation<sup>[9]</sup>.

Along with the implementation of the “National Technology Transfer Promotion Action”, a number of technology transfer demonstration institutions have flourished, technology transfer cooperation networks have continued to expand, technology transfer alliances in various regions have emerged, and the technology transfer alliance coverage has been expanding. However, there are still few studies on China's technology transfer cooperation network alliance. For a long time, China's technology transfer service organizations have a large number, small scale, technology transfer institutions have single service projects, and technology integration capabilities are not strong. Model institutions with scale and strong service capabilities drive the overall development of technology transfer service agencies. The cross-regional technology transfer alliance relationship is still relatively fragile, and the degree of cooperation among the members is not high, and substantial cooperation still needs to be further expanded. More critically, the current technology transfer alliance coordination organization is the government, but the market as the main body of the market has not participated in the decision of the technology transfer coordination organization, or even joined the technology transfer cooperation alliance, which makes the government-led technology transfer alliance. The lack of substantial links between technology transfer and cooperation networks with technology transfer institutions and enterprises as the mainstays has caused the technology transfer alliances to be less sensitive to the perception of market demand. It is difficult for technology transfer alliances to achieve substantial cooperation effects. Promote the development of technology transfer institutions. Jiangsu Province is one of the regions where China's science and technology resources are relatively concentrated, innovation vitality is more prominent, and technology transactions are more active. It is an important hub and key node for implementing the Yangtze River Delta coordinated development strategy and the “One Belt, One Road” national strategy.

By studying the technology transfer alliance between Jiangsu Province and the countries along the “Belt and Road”, it proposes policy recommendations for optimizing cross-domain technology transfer, which is conducive to Jiangsu Province to play its own advantages, accelerate the integration and flow of scientific and technological innovation resources in the province, and promote innovation through technology transfer. Entrepreneurship, with the concept of open sharing, realize the transnational, cross-border and leap-forward development of technology transfer, and enhance China's overall scientific and technological competitiveness and the level of foreign scientific and technological cooperation.

Based on this, this paper chooses the cooperative application patent as the research object, and conducts a comprehensive and objective description and comparative analysis of the innovation cooperation between Jiangsu Province and the “Belt and Road” countries.

## 2. Data Sources

Drawing on the views of Zheng Jia and Liu Yun, the inventor's nationality contains the patents of China and the “Belt and Road” countries as cooperative patents, regardless of whether there are other non-“Belt and Road” countries. The US Patent and Trademark Office (USTPO) patent application library searches for the inventor's nationality as a cooperative patent between China and the corresponding “Belt and Road” countries. The time range is from 2001 to the present (February 2018). Since there is no code information in the three countries of Palestine, Serbia and Montenegro in USTPO, it is not included in the search. The actual cooperation data between China and 62 “Belt and Road” countries has been retrieved, and 1,751 records have been obtained. On the one hand, inconsistencies in indexing, errors in input, synonymous synonymous words, different ways of writing the author or inventor, different expressions of scientific research institutions or patent licensors may lead to errors in the data. <sup>[10]</sup> On the other hand, due to the existence of third-party inventors, third-party inventors may have other countries in the “Belt and Road”, resulting in duplicate search records. Therefore, in this paper, the two fields of the inventor and the applicant are sorted out, and the deduplication processing is performed according to the patent number of each patent and the uniqueness of the publication number. A total of 21 repetitive options were deleted, and 1,730 patents were obtained, all of which were invention patents.

## 3. National Innovation Cooperation between Jiangsu Province and the Belt and Road Initiative

### 3.1 The overall distribution of innovation cooperation between Jiangsu Province and the “Belt and Road”.

Among the 62 “Belt and Road” countries, only 35 countries have cooperation patents with China, and Singapore, India, Russia, Israel and Malaysia rank in the top 5 (see Table 1 for details), which are 663 and 349 respectively. 153 cases, 148 cases and 87 cases.

Country (Abbreviation)	Application Amount
Singapore (SG)	663
India (IN)	349
Russia (RU)	153
Israel (IL)	148
Malaysia (MY)	87
Poland (PL)	49
Philippines (PH)	42
Thailand (TH)	41
Czech Republic (CZ)	35
Hungary (HU)	24

According to the provinces where the Chinese inventors are located, the data can be classified into the provinces and municipalities directly under the central government with patent cooperation in the “Belt and Road” countries (see Table 2 for details). The top five are Beijing, Shanghai, Guangdong, Jiangsu, and Zhejiang. The number of patents is 595, 471, 154, 87, and 39, respectively, accounting for 81.04% of the total number of patents. This shows that China and the “Belt and Road” countries Patent cooperation is more concentrated in Beijing, the Yangtze River Delta and Shenzhen, Guangdong.

Jiangsu Province has a total of 87 patents with the “Belt and Road” countries, accounting for 5.03% of the total number of patents, far lower than Beijing, Shanghai and Guangdong. The cooperation innovation capability needs to be strengthened.

Area	Patent cooperation
Beijing	595
Shanghai	471
Guangdong	154
Jiangsu	87
Zhejiang	39
Tianjin	35
Sichuan	21

The selected cooperative patents of Jiangsu Province and the “Belt and Road” countries are classified (see Table 3 for details). It can be seen that the cooperation objects in Jiangsu Province are relatively simple, and only have patent cooperation relationship with 9 “Belt and Road” countries. The overall trend of cooperation between the partners and China and the “Belt and Road” countries is the same, but the order of cooperation is slightly different.

Country (Abbreviation)	Application Amount
Singapore (SG)	41
Philippines (PH)	13
Israel (IL)	8
India (IN)	6
Czech Republic (CZ)	6
Malaysia (MY)	5
Saudi Arabia (SA)	5
Russia (RU)	2
Poland (PL)	1

### 3.2 Time trend of innovation cooperation between Jiangsu Province and the “Belt and Road” countries

The cooperation patents between China and 35 countries along the “Belt and Road” are analyzed in time series. The specific trend is shown in Figure 1. Overall, the average annual growth rate of cooperative patents in 2001-2017 was 20.58%, which was in a state of rising.

The cooperation patents between Jiangsu Province and the nine countries along the “Belt and Road” will be analyzed in time series. The specific trend is shown in Figure 2. Overall, the average annual growth rate of cooperative patents in 2001-2017 was 47.72%, showing a rising trend. Compared with the overall trend, the average annual growth rate of cooperation patents between Jiangsu Province and the countries along the “Belt and Road” is much higher than the average annual growth rate of cooperation patents between China and the countries along the “Belt and Road”. It shows that from the perspective of the whole country, Jiangsu Province and the countries along the “Belt and Road” have stronger willingness to cooperate and cooperate, with higher cooperation efficiency and stronger sustainable development level. In particular, after 2013, the number of patent cooperation continued to rise,

indicating that Jiangsu Province closely follows the national “Belt and Road” strategy, strengthens cooperation research, and provides strong support for building an innovative country.

According to the time series distribution of cooperation patents, the scientific and technological cooperation between Jiangsu Province and the “Belt and Road” countries can be divided into three stages. The first phase is the start-up period (2001-2006), and the average number of cooperative patents is 1.83. The second stage is the period of volatility growth (2007-2013), and the average number of cooperative patents is 5.43, which is three times that of the first stage. The third stage is the rapid growth period (2014-2017), and the average number of cooperative patents is 9.5, which is five times that of the first stage.

Figure 1: China and the “Belt and Road” countries cooperate patent timing distribution

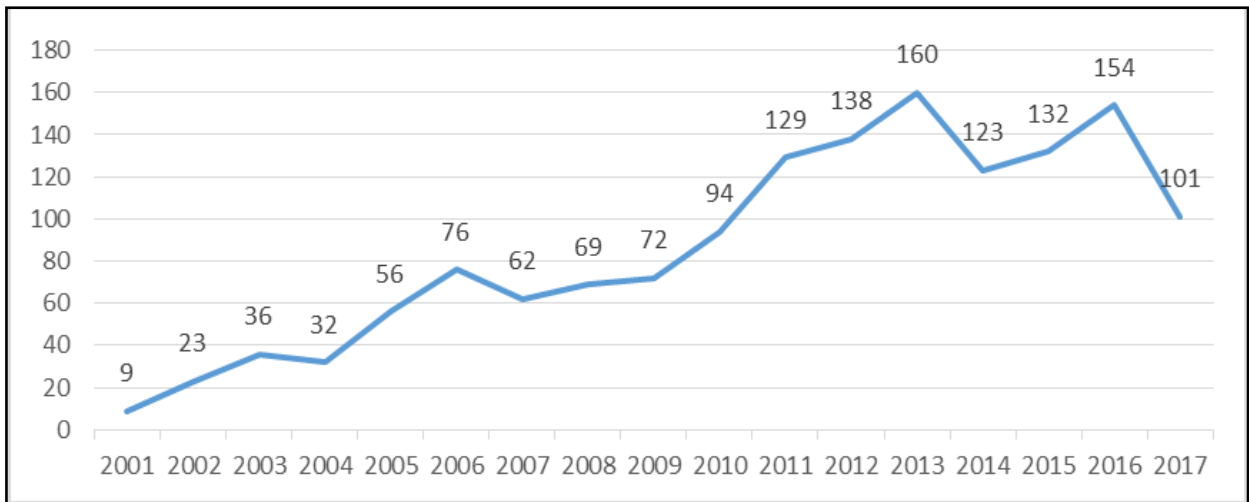
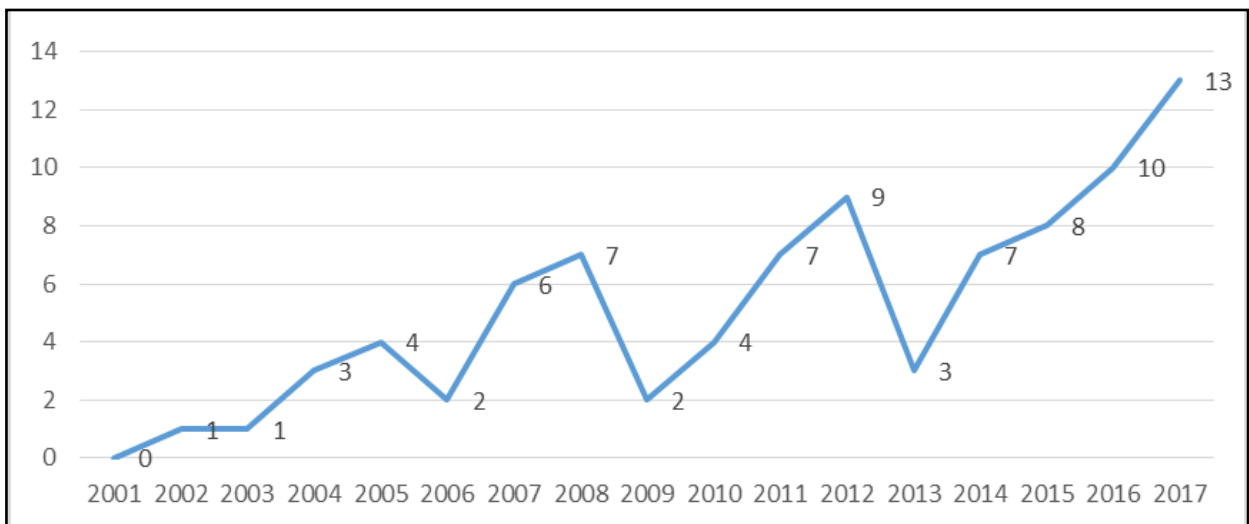


Figure 2: Distribution of patents in Jiangsu Province and the “Belt and Road” countries

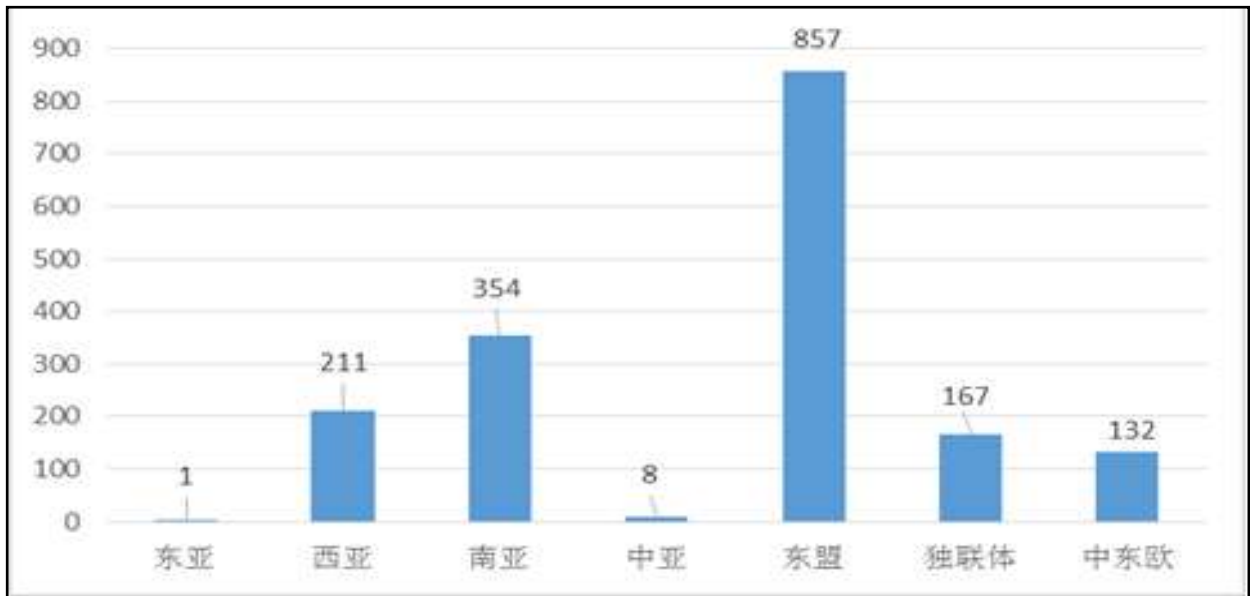


### 3.3 The spatial trend of innovation cooperation between Jiangsu Province and the “Belt and Road”

There are 65 countries along the “Belt and Road”, divided into 7 districts, namely East Asia Mongolia, West Asia 18 countries, South Asia 8 countries, Central Asia 5 countries, ASEAN 10 countries, CIS 7 countries and 16 countries in Central and Eastern Europe.

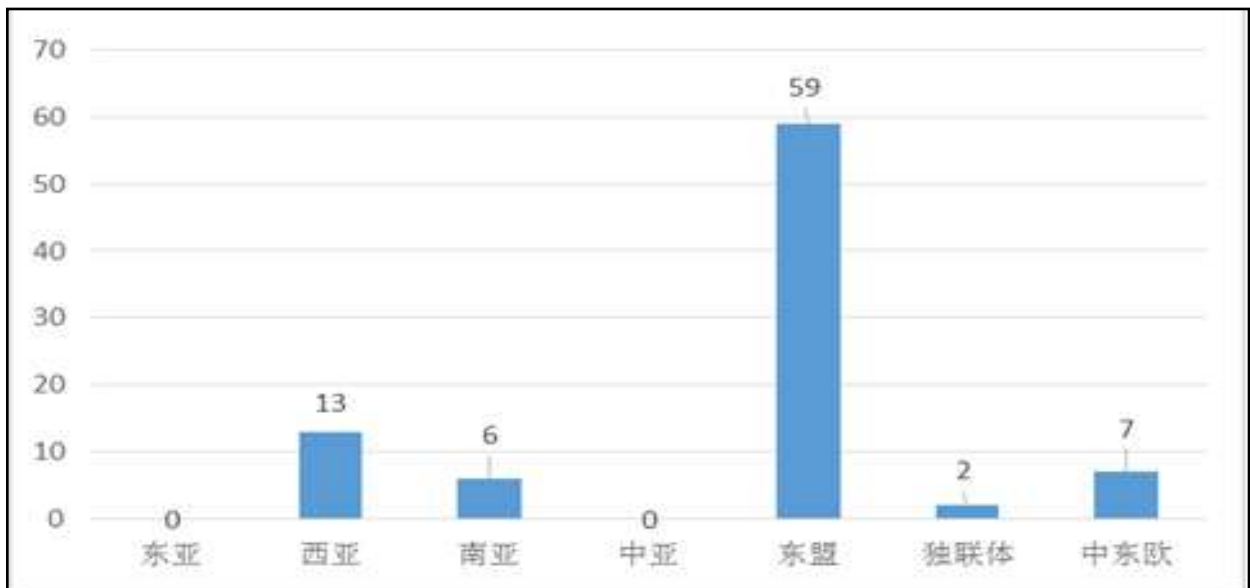
According to the national statistical data of the countries along the “Belt and Road”, according to the national statistical standards of the countries along the “Belt and Road”, the number of national patent applications in the 7 districts along the “Belt and Road” in China as shown in Figure 3 will be obtained.

Figure 3: Number of patent applications between China and the “One Belt, One Road” seven regions



The nine countries that have applied for patents in cooperation with Jiangsu Province are classified according to the seven major regions, and the number of national patent applications in the 7 districts along the “Belt and Road” in Jiangsu Province as shown in Figure 4 is obtained.

Figure 4: Number of patent applications for cooperation between Jiangsu Province and the “One Belt, One Road” seven regions



As can be seen from Figure 3 and Figure 4, Jiangsu Province has more patent applications for cooperation with ASEAN and West Asia countries, and has less patent cooperation with East Asia and Central Asia. This is in line with the trend of patent applications between China and the “One Belt, One Road” seven regions. Roughly the same.

### 3.4 Technical Fields of Innovation Cooperation between Jiangsu Province and the Belt and Road Initiative

According to the one-to-one correspondence between the patent IPC classification number published by WIPO and the technical field, there are 35 technical fields [11]. An analysis of the technical fields of patent applications between Jiangsu Province and the “Belt and Road” countries can provide an understanding of the technological advantages and technical disadvantages of Jiangsu Province, and provide suggestions for better technical cooperation.

According to the statistics of the technical field, the technical fields of the patent applications for cooperation between Jiangsu Province and the “Belt and Road” countries are shown in Table 4.

Technical field	Number of patents
Electricity	38
Essential for human life	14
Physical	13
Chemistry	7
Operation	7
Metallurgy	3
Mechanical engineering	2
Transport	2
Illumination	1

It can be seen from Table 4 that the top nine technical fields in Jiangsu Province and the “One Belt and One Road” national cooperation patent application are respectively in electricity, human life, physics, chemistry, operation, metallurgy, mechanical engineering, transportation and lighting. Among them, the number of cooperative patent applications in the field of electricity is the most, and the advantages are more prominent than the last eight technical fields. The top 9 technical fields in Jiangsu Province and the “One Belt and One Road” countries have also reflected the field trend of patent distribution in Jiangsu Province.

#### 4 Conclusion

After analyzing the cooperation patents between Jiangsu Province and the “Belt and Road” countries, there are four main characteristics.

- i) The cooperation time presents a phased feature. Science and technology cooperation generally maintains a growth trend and can be divided into three phases: the first phase is the initial phase (2001-2006), and the average number of cooperative patents is 1.83. The second stage is the period of volatility growth (2007-2013), and the average number of cooperative patents is 5.43, which is three times that of the first stage. The third stage is the rapid growth period (2014-2017), and the average number of cooperative patents is 9.5, which is five times that of the first stage.
- ii) The cooperation area presents an unbalanced feature. Among the 65 countries along the “Belt and Road”, only 9 countries have cooperation patents with Jiangsu Province, and no other countries have cooperation. Among the nine countries, the top five cooperative patents are Singapore (41), the Philippines (13), Israel (8), the Czech Republic (6) and India (6).
- iii) The technical field and direction of cooperation are more focused. The five technical fields with the most cooperation patents between Jiangsu Province and the “Belt and Road” countries are electricity (38), human life (14), physics (13), chemistry (7) and operations (7). 79, accounting for 90.80% of the total, the most active partner countries in these areas are Singapore, the Philippines and Israel.
- iv) The technology transfer between Jiangsu Province and the countries along the “Belt and Road” is mainly distributed in West Asia, South Asia, CIS, Eastern Europe, Central and Eastern Europe, lack of technology transfer and exchange with East Asia and Central Asia, which is related to Jiangsu Province and the “Belt and Road” The distribution of patent applications in the seven major regions is the same, with the difference being that Jiangsu Province focuses on technology transfer with Central and Eastern European countries, and the cooperation patents with the Belt and Road countries focus on ASEAN.

In view of the research focus and the length of the paper, no more detailed information, such as applicants, keywords or keyword analysis, can be explored in the future.

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