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Investment value analysis of China's participation in port projects along the 21st century maritime

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Investment value Analysis of China's Participation in Port Projects along the 21st Century Maritime Silk Road

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DECLARATION

I certify that all the material in this research paper that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this research paper reflect my own personal views, and are not necessarily endorsed by the University.

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(Date): 2021.6.24

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ABSTRACT

Title of Research paper: Investment value Analysis of China's Participation in Port Projects along the 21st Century Maritime Silk Road

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Since the initiative of "21st century Maritime Silk Road", China has been cooperating with overseas countries to build a modern port operation system. At present, China has carried out various modes of investment and construction in ports of more than ten overseas countries. In this context, what is the overall Investment value of the ports China participates in? Does the port have development prospects? How to further improve the comprehensive competitiveness of the port? As an enterprise, should the invested projects be withdrawn or continue to develop?

This paper studies the Investment value of ports in more than ten major countries along the 21st century Maritime Silk Road, including Southeast Asia, South Asia, Middle East,Africa and Europe. In this paper, through the establishment of port Investment value evaluation index system, the principal component analysis method is used to calculate the Investment value of ports in countries along the maritime Silk Road. The main conclusions are as follows:The Investment value of a port mainly depends on its geographical location,port infrastructure level,economic factors and political environment of the host country; The method to improve the Investment value of port in a short time is to improve the level of infrastructure construction; China's port investment along the 21st century Maritime Silk Road is full of risks. Before investment, investment enterprises should fully understand the political situation, economic situation, legal policies and other factors that will affect the port investment and construction.

Key Words:The 21st century Maritime Silk Road; Port Investment value; Principal component analysis

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Chapter 1: Introduction

1.1 Background of this study

The concept of the Silk Road, which originated in ancient China, was an important road for political, economic and cultural exchanges between China and the West. The 21st century is an era of close connections between countries. Win-win cooperation is the theme of today's world. That's why Chinese President Xi Jinping put forward the initiative of building the 21st Century Maritime Silk Road in 2013. The maritime silk road in the 21st century strategic partners and not only limit and the association of south-east Asian nations (Association of South East Asian Nations), but in point of belt line, in line with the surface, improve the surrounding countries and regions, the string connected association of South East Asian Nations, South Asia, west Asia, north Africa, Europe and other major economic sector of the market chain, developing strategic cooperation for the south China sea, the Pacific and Indian Ocean economic belt, with Asia-Europe economic trade integration for the development of long-term goal. The Vision and Actions for Jointly Building the Silk Road Economic Belt and the 21st Century Maritime Silk Road issued by China in 2015 proposed to strengthen the construction of port infrastructure, improve the degree of communication and cooperation between ports of countries along the maritime Silk Road, and build a development community with a shared future for ports of countries along the maritime Silk Road.

Figure1-1:Maritime Silk Road Map

Source：http://www.cssn.cn

In the process of One Belt And One Road development, the investment of

infrastructure construction funds plays a particularly key role. Port is the hub of traffic and transportation in maritime trade, which is the gathering and distributing center of goods as well as the storage and transportation center. It is the most important infrastructure. Therefore, in recent years, China has invested in ports in coastal areas of Asia, Africa and Europe in a variety of ways, including wharf operation, wharf construction, investment and investment, etc. Chinese enterprises have cooperated smoothly in projects such as the Royal Port in Malaysia, Singapore Port in Singapore and Busan Port in the Republic of Korea. China has established contacts with more than 600 ports in more than 200 countries, and more cooperation projects are in the pipeline. With closer links between China and countries along the Maritime Silk Road, more and more Chinese enterprises have participated in the investment and construction of foreign ports.

1.2 The purpose of the study

Since the "Maritime Silk Road" initiative was put forward in 2013, more and more Chinese enterprises have invested in the construction of foreign ports. With the further development of this initiative, China will participate in the construction and investment of more ports. As an international power, China has the ability to invest in ports from both technical and financial aspects. So, for now the investment and the upcoming cooperation overseas ports to establish a practical index system, make reasonable evaluation, and to determine construction investment priority for countries and enterprises for overseas ports of strategic development focus adjustment has a certain reference Investment value, makes the port construction, investment, have a clear direction, let the "maritime silk road in the 21st century" fast and steady development of the strategy.

1.3 Relevant research status at home and abroad

Port plays an important role in the development of the 21st century Maritime Silk Road. Port cooperation and trade are the key development direction of the "21st

century Maritime Silk Road" strategy. A large number of scholars at home and abroad have carried out academic research on the comprehensive competitiveness and Investment value of the port.

1.3.1 Abroad Research

Jasmine Siu Lee Lam, Kevin Patrick Brendan Cullinane and Paul Tae-Woo Lee put forward that there exists a challenge in that ports must prepare for changes in the way they compete, which may lead to increases in cargo volume for some, and less for others.Ports must find their own strategic advantages if they want to develop on the maritime Silk Road.Therefore, the natural conditions, shipping conditions and external conditions of the port are included in the evaluation criteria of port competitiveness.Moreover, they put forward another important dimension is logistics performance. This involves inland accessibility, transportation infrastructure, information and communication, Investment value-added services, etc.[1]

Peng Peng, Yu yang, Feng Lua,Shifen,chenga,Naixia,moufren Yang established the comprehensive competitiveness evaluation model by using the entropy analytic hierarchy process, which comprehensively considered the four factors of port conditions, capacity, potential and efficiency. It is pointed out that the construction of roads and railways inside a port will further increase the flow of goods and significantly improve the location advantage of the port.[2]

Marcella de Martino and Alfonso Morvillo pointed out that although port competitiveness is still closely related to structural type variables (GEO economic background, institutional model and connecting infrastructure), it is increasingly dependent on the software components of port business, including the scope of services provided, the existence of information and communication technology systems for information exchange between the same port community and other port community actors, and the specialization of maritime industry The level and intensity of the relationship between knowledge and actors.[3]

Chi Lok, Andrew Yuen, aming Zhang and waiman Cheung proposed that the competitiveness of ports in different port user groups is different, "costs at port" is the most important factor for shipping liners, while "port location" is the most important

factor for both forwarders and shippers.[4]

1.3.2 Domestic Research

In the evaluation of port competitiveness,Chen Yingying,Zhang Jiantong use Entropy TOPSIS method to evaluate the port from the five aspects of port infrastructure, production capacity, business environment, development potential, collection and distribution capacity and carrying capacity. From the results, they conclude that the port infrastructure and port productivity play a decisive role in the port competition.[5]

Ding Changyuan pointed out in the research on the competitiveness of Dalian port in the Bohai Rim port group that the natural environment, production and operation status, infrastructure level, operation and management level, operation efficiency and production capacity of the port are the main factors affecting the competitiveness of the port.[6]

Wang Aihu comprehensively evaluated the index calculation method of port competitiveness from subjective and objective dimensions. He believed that the establishment of evaluation method should adhere to three index factors: multi-agent decision-making method, systematicness and shared hinterland.[7]

Kuang Haibo and Chen Shuwen established an evaluation index system based on port throughput, port operation capacity and other factors, and comprehensively evaluated the comprehensive competitiveness of Dalian port, Shanghai port and other domestic ports by Using Entropy TOPSIS method.[8]

Cao Xiaofa proposed that based on the application reliability and validity analysis dimension, the humanities and social science environment of port development should be considered, including the social and economic environment of port hinterland, the economic development strategy of hinterland, the total economic volume of port hinterland, the port infrastructure, the degree of legal perfection, the number of talents and technical safety.[9]

Zhang Pengfei used China's one belt, one road, 35 Asian countries' transportation infrastructure data for 2010-2015 years. Under the extended gravity model, we found that the transportation and communication infrastructure had positive effects on bilateral trade between China and the countries along the line, and the promotion

effect was different from the income level of the countries of the import and export.[10]

Zhong Hao analyzed the current situation of ports of major countries along the 21st Century Maritime Silk Road, including the general situation of ports of major countries along the road. The operation of ports in countries along the Belt and Road.[11]

Huang Qingbo and Lin Hanlong discussed the risks of China's investment in ports of countries along the Maritime Silk Road from the perspectives of government, enterprises and international environment, and put forward some policy suggestions to avoid risks.[12]

Li Wei studied six ASEAN countries along the maritime Silk Road, including Indonesia, Thailand, Malaysia, Philippines, Vietnam and Cambodia. Based on their own economic development level and the actual situation of port infrastructure, he constructed a set of strategies that can fully reflect the level of cooperation between ASEAN countries and China in the political, economic, cultural and other fields, as well as fully reflect the development trend of ASEAN countries Evaluation index system of domestic participation in the construction of "21st century Maritime Silk Road".[13]

Zhang Shucun pointed out that the risks and challenges of China's investment in countries along the "Belt and Road" mainly come from social turmoil, political turmoil, and intense economic volatility.[14]

Zhou Zhiqiang believes that the biggest risk facing the Maritime Silk Road ports is political risk, and 80 percent of failed projects are due to political conflicts between countries. Political instability, environmental protection, labor disputes and major power games may pose major challenges to the safety and sustainability of port investment projects.[15]

Lv Yongbo established the evaluation index system of port comprehensive competitiveness from the aspects of port geographical location, port operation level and efficiency, port cargo throughput and growth rate, port infrastructure improvement degree and port informatization level.[16]

Song Bingliang used the probabilistic traffic volume allocation model to calculate the

generalized transportation routes of Shanghai port, Qingdao port and Lianyungang port, and conducted an empirical study on the competitiveness of ports in the southeast coastal areas.[17]

Taking Ningbo Zhoushan Port as the main research object, Wu Zujun made an empirical analysis on the competitiveness of Ningbo Port, Shanghai Port, Guangzhou Port, Qingdao Port and Tianjin Port through factor analysis, put forward the advantages and disadvantages of the development of Ningbo Zhoushan Port, and further put forward countermeasures and suggestions to improve the competitiveness of Ningbo Zhoushan Port.[18]

Du Mingjun thinks that the intelligent and information construction level of the port is the core element to improve the comprehensive competitiveness of the port.[19]

Guo Zhen pointed out that service efficiency and innovation ability are the core factors that directly affect port competitiveness.[20]

The author believes that the elements of Investment value of ports have been well explored at home and abroad, such as port infrastructure, production capacity, collection and distribution capacity, carrying capacity, hinterland economy and other indicators. However, factors that cannot be qualitatively measured, such as politics, culture, and law, are not considered. Therefore, the author believes that when evaluating the Investment value of a port, the quantitative port Investment value should be combined with political, cultural, legal and other potential factors to comprehensively evaluate the Investment value of a certain country’s port.

1.4 Research idea, content and method

This article uses qualitative and quantitative perspectives to study the Investment value of ports, so the following two research methods are used to explore.

1.4.1 Research idea

The author takes the Investment value of the ports along the 21st century maritime silk road that China has invested and is expected to invest as the research object, and constructs the evaluation index system of the Investment value of the ports of the main countries along the maritime Silk Road Based on the data of the ports of the

main countries along the maritime Silk Road, Finally, the future investment direction of China is discussed according to the results.

1.4.2 Research content

This article is divided into five parts. The first part is the introduction, which mainly includes the background, significance and exploration of port Investment value analysis at home and abroad. This paper mainly introduces the trade cooperation between China and foreign countries since the 21st century Maritime Silk Road initiative.

The second chapter analyzes the current situation of the main ports along the 21st century Maritime Silk Road. It mainly includes the geographical location and policies of the port countries along the 21st silk road; Port infrastructure level, container throughput, liner linear correlation index; Cooperation mode and successful cases between countries.

The third chapter is to build the evaluation index system of the Investment value of the ports of the main countries along the 21st century Maritime Silk Road. By using the principal component analysis method to calculate and sort the Investment value of the selected national ports, we can see the Investment value of each port more intuitively.

The fourth chapter analyzes the Investment value orientation of port investment in various regions on the basis of the third chapter. And for the port Investment value evaluation index comparative analysis. Finally, the paper summarizes the situation and gives the investment suggestions based on the current situation of the port.

The fifth chapter is based on the calculation results of the third and fourth chapters, puts forward the measures to improve the Investment value of the port and the general direction of China's investment in overseas ports.

1.4.3 Research method

(1)Literature research method.By combing the relevant literature, we can understand the research status of China's participation in the port development of the 21st century Maritime Silk Road, and systematically study the Investment value of the 21st century Maritime Silk Road.

(2)Principal component analysis. Through the establishment of the evaluation index system of the Investment value of the ports of the main countries along the 21st century Maritime Silk Road, based on the collected data, the Investment value of the ports of the main countries is calculated.

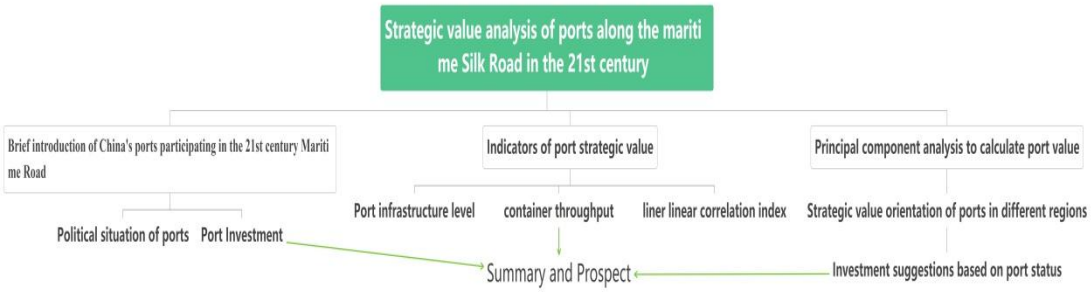

Figure 1-1:Article mind map

Chapter 2：Analysis on the current status of ports along the maritime Silk Road

The second chapter firstly introduces the construction and investment status of China's Maritime Silk Road, then analyzes the typical cases of successful cooperation between China and foreign countries, and finally introduces three quantitative parameters to measure the Investment value of the port.

2.1 China's participation in the maritime Silk Road

Judging from the overseas investment, construction and operation of Chinese enterprises in recent years, 65% of them are located along the 21st century Maritime Silk Road, and Chinese enterprises have participated in more than ten national port projects along the maritime Silk Road. In the first two one of the "one belt, one road" initiative, most of the port construction enterprises "go out" mainly export the technology of terminal construction and give the capital support for the construction of wharf. In the past two years, port operation enterprises have accelerated the layout of going out, including Qingdao port group, Guangxi Beibu Gulf port group, Yantai Port Group, China Merchants port, COSCO Shipping Port and other enterprises.

Although most of the countries along the maritime Silk Road in the 21st century are developing countries with unsatisfactory infrastructure and port conditions, with the steady development of economy and trade in recent years, significant progress has been made in port and wharf infrastructure, especially in Indonesia, Malaysia, Thailand, the Philippines and other countries in Southeast Asia, as well as India, Pakistan, Thailand and the Philippines in South Asia Sri Lanka and other countries have made great achievements in speeding up port construction and opening up maritime trade channels, and the port carrying capacity and collection and distribution conditions have been greatly improved. [22]For example, Indonesia proposes to build a regional shipping center, which will use US $6-7 billion to transform 20-25 existing ports in Indonesia and build 10 new ports. In contrast, the construction progress of

ports in West Asia where the United Arab Emirates, Turkey, Iran and Saudi Arabia are located and in northeast Africa where Egypt, Sudan and Djibouti are located is relatively slow, the contradiction of production capacity is gradually revealed, and there is a certain investment demand.

2.1.1 Port distribution

There are two major trends of the maritime Silk Road in the 21st century. 1. From China's coastal ports through the South China Sea, through the Strait of Malacca to the Indian Ocean, to Europe. 2. From China's coastal ports across the South China Sea to the South Pacific.

China's port investment areas mainly include Southeast Asia, South Asia, Middle East, Africa and Europe.

Among the Southeast Asian port countries with China's investment and cooperation, Myanmar, Singapore, Indonesia, Cambodia, Thailand, Malaysia, etc. most of the ports are located in the Strait of Malacca. The Malacca Strait accounts for 1 / 4 of the world's maritime trade, and 1 / 4 of the world's oil tankers pass through the Malacca Strait, which is three times as many as the Suez Canal and five times as many as the Panama Canal.[23] China is the largest user of the Strait of Malacca. 60% of the ships passing through the Strait Travel to and from China every day. 80% of China's oil imports and 50% of its goods and materials are transported through the Strait. Among them, the port cooperation between China and Malaysia is the closest: Guangxi Beibu Gulf officially participated in the construction of Malaysia's Guandan port in 2013, Shenzhen port and basheng port concluded a friendly port in 2015, Guangxi Beibu Gulf port and basheng port concluded a friendly port in 2015, and China Power Construction Group invested in the construction of Huangjing port in 2016, In the same year, Malaysia's Klang Port Free Trade Zone signed a strategic cooperation agreement with China's taifuji. The two sides will cooperate in the investment and construction of the cold chain project of the Klang Port Free Trade Zone by reloading port equipment abroad.

China's investment in South Asian ports mainly includes Bangladesh, Pakistan and Sri Lanka, among which China and Sri Lanka have close cooperation. In 2011, China

Merchants obtained the 35 year operation right of the container terminal of Colombo port, in 2014, China Communications Construction invested in the development of Colombo port city, and in 2017, China Merchants obtained the 99 year operation right of hanbantot port of Sri Lanka.

Among the ports in the Middle East that China has invested in, there are mainly Israel, Djibouti, UAE, Iran, Saudi Arabia, Qatar and Turkey, among which the most recent port cooperation project with Israel is the one. In 2014, China Bay built a $950 million port in Ashdod on Israel's Mediterranean coast; In 2015, Shanghai Port obtained a 25-year lease of Haifa port in Israel.

Among the African ports that China has participated in the investment, Nigeria, Tanzania, Cote d'Ivoire, Togo,Algeria and Guinea are the main ones, among which the port cooperation with Nigeria is the closest. In 2010, China Merchants Group set up a joint venture to acquire Nigeria container terminal; In 2012, the EPC project of Nigeria's Leki deepwater port was officially signed by China harbor and Leki port company; In 2018, the construction of laichi deep water port project in Nigeria was started.

Among the European ports in which China participates in investment, there are mainly Ukraine, Greece, the Netherlands, Italy, Spain and other countries. In recent years, port investment and cooperation projects between China and Italy are the closest. In 2016, Qingdao port acquired 9.9% of the equity of Vado port in Italy, and COSCO invested in the construction of Vado container terminal in Italy in 2016.

The figure below shows the growth of container throughput in each region from 2008 to 2017：

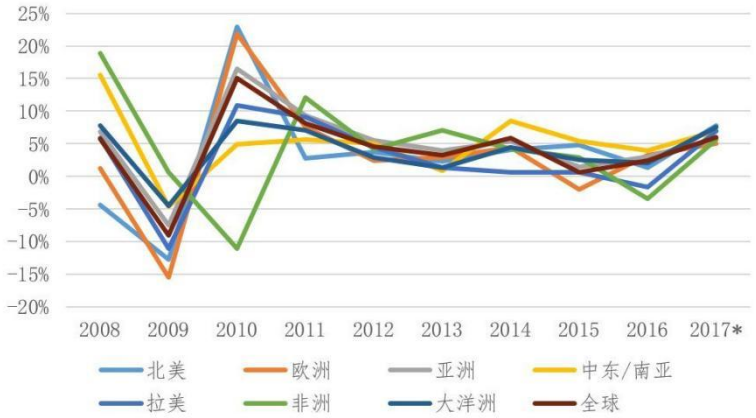

Figure2-1：Container throughput in different regions of the world from 2008 to 2017

Source：http://www.cssn.cn

Ports in South Asia are growing rapidly. South Asia is the region with the best port production growth in recent years, and the trade scale is in the initial stage, but it grows rapidly. Even in the financial crisis, Europe and the United States, Northeast Asia, Southeast Asia, Africa and other regions have different degrees of negative growth, the ports in South Asia basically maintain a good growth trend. The main ports of Pakistan, Sri Lanka and Bangladesh have maintained an average annual growth rate of nearly double-digit.

The performance of ports in Western Asia is different. Among the major ports in West Asia, Dubai, as a regional hub port in transition, has maintained steady and rapid growth in recent years, but the growth rate has declined year by year in recent two years. The main ports of Turkey, Iran and Oman have been affected by economic weakness and political turmoil in recent two years. The port production situation is not optimistic and the negative growth phenomenon is obvious.

The port growth in northeast Africa is unstable. The belt and road initiative, is connected to the Mediterranean region. Although the initial port operation is small, the industry has shown strong growth momentum in the past two years. However, due to various factors such as economy, politics and market, the port area in northeast Africa has a large fluctuation in its production and a low degree of stability.

2.1.2 Port political situation

The port political situation is an objective factor that affects the Investment value of

the port.Generally speaking, the political situation of overseas ports will change for the following three reasons:

1.The risk of port politicization caused by domestic political changes in port owner countries:On the one hand, due to the change of the ruling parties in China, some projects that have started cooperation before may become more difficult or stop due to the adjustment of policies by other political parties. On the other hand, port construction may involve a series of environmental and legal issues, and domestic public opinion may have a significant impact on investment projects.[24]

2.The political changes caused by the interest competition between neighboring countries.In the 21st century, the relations between neighboring countries along the maritime Silk Road are tense, and there are still hot conflicts involving many countries in the Middle East and Africa. For example, China's participation in the construction of Ashdod port and the Red Sea Mediterranean railway in Israel has caused tension and opposition in Egypt, which is worried that the status of the Suez Canal will be affected. In Southeast Asia, Singapore has expressed serious concern about China's participation in the construction of Malaysia's Huangjing port, fearing that its position as a global hub port will be weakened.

2.2 Port investment status

Since China participated in the 21st Century Maritime Silk Road, there have been many overseas ports. At present, the main investors are state-owned enterprises, and the investment mode is mostly port construction investment.

2.2.1 Investment subject

Since China took part in the 21st century Maritime Silk Road, it has invested a lot of capital and manpower. China has provided port investment cooperation in all aspects from the aspects of laws and policies, technical level, capital guarantee, etc. At present, China's overseas port cooperation enterprises are mainly large state-owned enterprises such as port engineering construction enterprises, survey planning and design enterprises, port machinery manufacturing enterprises, etc. Among them, the most typical are China Merchants port and COSCO Shipping Port.[25]

By the end of 2020, China Merchants will have invested more than US $2 billion in overseas ports, with 49 ports in 19 countries and regions. One belt, one road, is the most important port along the "one belt" road, for example: the international container terminal in Colombo, the port of hanto toto in the south, the port of Djibouti in the Red Sea entrance, the port B at Nigeria, Lagos, the second largest West African dock, the Togo Lome container terminal, and the Turkey quintown dock.

Among the nearly 30 ports invested by COSCO in the world, there are 11 wharves along the 21st century Maritime Silk Road, most of which are in European countries. Since 2015, the container terminals that have been operated include Istanbul port in Turkey, Piraeus port, the largest port in Greece, euromax container terminal in Rotterdam, the Netherlands, large container terminal in Singapore jointly invested with Singapore port group, and phase II container terminal of caliphate port in Abu Dhabi in the United Arab Emirates.

2.2.2 Investment patterns

The cooperation modes of the 21st century Maritime Silk Road ports can be simply divided into five categories: investment in port construction, investment and equity participation, equity control, Port Alliance and Infrastructure investment.

(1)Investment in port construction:Investment in port construction is the key direction of China's participation in the 21st century Maritime Silk Road overseas port cooperation. China's promotion of ports along the maritime silk road is mainly based on the port infrastructure enterprises of China's large state-owned enterprises. Through overseas port investment and construction, the port layout of China's Maritime Silk Road in the 21st century can be realized. Ports are distributed in Asia, such as Huangjing port in Malaysia, Gwadar Port in Pakistan and Bagamoyo new port in Tanzania.

These ports generally have the following three characteristics: 1. The target port has a prominent geographical location and is located at the key throat of the world shipping waterway. According to the U.S. energy information administration, there are seven major oil fjords in the world, the most important of which are the Strait of Hormuz and Malacca, and the other five are the Suez Canal, Mander Strait, Denmark Strait,

Turkey Strait, and Panama Canal. Malacca Strait, the second most important channel, is located between the Malay Peninsula and Sumatra island in Southeast Asia. It is the shortest route from the Middle East to Asia and the most important throat in Asia. Chinese enterprises have invested about 80 billion yuan in Malaysia this year to build a new deep-water port, Huangjing port, in the Strait of Malacca. Last year, China also signed an agreement to invest in three new large berths at Singapore port. 2.The influencing factors of overseas investment in port construction are complex, involving economic, physical geography and political relations.3.The overseas layout of investment in port construction mainly focuses on the important hub ports and trunk ports along the 21st century Maritime Silk Road.

(2) Investment and equity participation is a common mode of port layout along the maritime silk line for Chinese port enterprises, mainly through investment in shares and participation in port operation. Investment shares account for a small proportion in the share of equity. Generally, both parties set up a consortium company to jointly invest in the construction project. After the project is completed, the consortium company will operate the project, and both parties will enjoy the income right according to the proportion of investment. Compared with the two cooperation modes of investment in Hong Kong and equity control, the resistance of investment and equity participation is relatively small.The modes of investment and equity participation are mainly concentrated in Singapore, Italy and Bangladesh.[26] Compared with other countries in the region, the three countries have maintained a relatively stable friendly and cooperative relationship with China for a long time.

(3)Equity control is a measure for Chinese port enterprises to participate in the layout of overseas ports along the 21st century Maritime Silk Road and obtain substantial control. The mode of equity control is mainly through the acquisition of port shares, so as to obtain the operation and management right or lease right of the target port. The mode of equity control is mainly concentrated in European countries, which is characterized by developed hinterland economy, large port cargo throughput, perfect infrastructure and operation network. With the implementation of the 21st century Maritime Silk Road initiative, the entry of Chinese port enterprises has

brought capital and vitality to the ports of European developed countries, mainly in the field of ports and other infrastructure, and the key field is the cooperation of port management rights.

(4)Port Alliance refers to the bilateral friendly cooperation agreement or contract signed between ports, stipulating the mutual benefit of bilateral ports in port logistics, port operation, port information exchange, infrastructure cooperation, etc. The cooperation mode of Port Alliance is an important way to continuously deepen the 21st century Maritime Silk Road.[27] The cooperation mode between China and the Port Association of countries along the maritime silk road is mainly concentrated in Southeast Asian countries. Port Alliance is the need to increase the negotiation ability with shipping alliance. In order to reverse the imbalance between ships and ports caused by shipping alliance, the establishment of appropriate port alliance among ports in the same region can improve the market competitiveness and have greater bargaining power in the game; Port Alliance is the need to limit vicious competition. By formulating unified operation rules and carrying out specialized division of labor according to cargo type, ship type and wharf capacity, regional ports can effectively regulate market order and greatly reduce the common losses brought by vicious competition to port industry; The port alliance can improve the utilization rate of resources, establish the port alliance, determine the overall strategic goal of the development of the port industry in the region through consultation and coordination, and on this basis, appropriately allocate the port resources such as coastline, berths, large special equipment, etc., so as to make the Limited investment play the best economic benefits and form the complementary advantages of each port, Large scale operation pattern of mutual support; Port Alliance is the need to enhance the competitive advantage of regional economy. The economically developed regions often regard the construction of developed ports as an important strategic choice, and regard ports and shipping as an important support to accelerate economic growth; Port Alliance is the need of technological innovation in port industry. The establishment of Port Alliance can share huge scientific research expenses and achieve the goal of sharing the technological development achievements.

(5)Infrastructure project construction is an important part of the 21st century maritime silk road infrastructure interconnection. By the end of 2020, China's central enterprises have undertaken more than 3000 projects in countries along the maritime Silk Road, including infrastructure construction, energy resources development and international capacity cooperation. In 2015, China Bay undertook the construction of Doha New Port Phase I terminal project, in 2016, China invested in the construction of Iran's geshem island oil terminal, in 2017, China invested in the expansion project of Indonesia's tanjungbulu port, and in 2018, China Bay undertook the construction of Nigeria's Leki deepwater port project. The above investment is the cooperation mode of infrastructure projects.

The figure below is a summary of port cooperation projects between China and countries along the maritime Silk Road.

Table 1: Cooperative countries and ports of China's participation in the 21st century Maritime Silk Road

region	country	Cooperation mode	Cooperation time and Port project
Middle East	Iran	Infrastructure investment	In 2016, China participated in the construction of an oil terminal on the northern side of the Strait of Hormuz on the Iranian island of Kashmir
		Infrastructure investment	In 2013, China provided Iran with 60 million euros for upgrading the chabahar port on the border between Iran and Pakistan.
	Israel	Equity control	In 2015, Israel port development and assets company signed an agreement with Shanghai international port group, officially granting Shanghai port group a 25 year franchise of Israel Haifa new port terminal.
		Infrastructure investment	In June 2014, China Bay won the bid for Ashdod port project, which will build a port worth 950

			million US dollars in Ashdod, Israel, on the Mediterranean coast.
	The United Arab Emirates	Equity control	In 2016,COSCO Shipping obtained the operation right of phase II container terminal of Harry port.
	Djibouti	Investment in port construction	In 2013, China Merchants invested in the construction of Djibouti port, with an operation period of 99 years.
	Qatar	Infrastructure investment	In 2015, the first phase of Doha new port wharf project contracted by China Harbour was launched.
	Turkey	Equity control	In 2015, China Merchants Group acquired about 65% of the shares of kunport wharf.
	Saudi Arabia	Infrastructure investment	In 2018, China Power Construction won the bid for King Salman international comprehensive port facilities project.

South Asia	Sri Lanka	Investment in port construction	In August 2011, China Merchants Group signed a bot agreement with Sri Lanka for the South container terminal project of Colombo port, with a total investment of more than US $500 million.
		Investment in port construction	In 2017, China Merchants Port Holdings Co., Ltd. agreed to invest up to US $1.12 billion in port and maritime related business of Hambantota port.
	Pakistan	Investment in port construction	In March 2016, Pakistan awarded a total Investment value of 238 million US dollars

			in coal-fired loading and unloading dock and other projects to China Hydropower port and Waterway Construction Corporation.
		Investment in port construction	In February 2013, Pakistan officially transferred the operation right of Gwadar Port to China overseas port holding company.
	Bengal	Investment and equity participation	In March 2019, China harbor invested in the China Economic and industrial park project in daguigang, Bangladesh, with a total investment of US $100 million, and obtained 70% equity of the project company.
Africa	Ivory Coast	Investment in port construction	At the beginning of 2013, China Hong Kong company of China Communications Construction Co., Ltd. and Abidjan port authority of Ivory Coast signed an EPC business contract for Abidjan port expansion project, with a contract Investment value of about US $933 million.
	Tanzania	Investment in port construction	In January 2014, the signing ceremony of the implementation agreement for the development project of Bagamoyo port and Port Industrial Zone in Tanzania invested and constructed by Chinese companies was held.
	Angola	Investment in port construction	In August 2014, the opening ceremony of Lobito port expansion project in Angola was held.

Africa		Investment in port construction	In June 2015, the phase I project of Luanda fishing port oil depot expansion project in Angola contracted by the pipeline bureau has started, and the project has entered the full implementation stage.
	Nigeria	Investment and equity participation	In May 2012, the EPC project of Nigeria's Leki deepwater port was officially signed by China harbor and Leki port company.
		Infrastructure investment	In October 2019, China Bay invested US $500 million in the Leki deepwater port project in Nigeria.
	Congo	Investment in port construction	The matadi mbengu International Port Phase 1 project in Congo is designed and constructed by China Railway seventh group, with a total cost of 56.5 million US dollars and a total construction period of 23 months. The project started on February 4, 2015.
		Investment in port construction	In february2016, China road bridge, affiliated to CCCC group, signed a business contract for the new port project in Heijiao with the Ministry of land and resources management and large-scale engineering of Congo (BU), with a contract Investment value of US $2.3 billion.

Europe	Italy	Investment and equity participation	On October 12, 2016, COSCO Shipping waduo company, a wholly-owned subsidiary of COSCO Shipping Port, signed a share sale agreement with Maersk Wharf on the purchase of 40% of the issued share capital of Vado holding B.V.
		Investment in port construction	In November 2016, the consortium composed of China Communications Construction won the bid for the first phase design project of Venice offshore deepwater port in Italy.
	Belgium	Investment and equity participation	In November 2004, COSCO Pacific signed a share purchase agreement with P & oports, which will obtain 25% equity of the joint venture company in Antwerp Port, Belgium, and the operation right of the port project.
		Investment and equity participation	On March 31, 2014, CNOOC Group and Maersk Group signed an investment and related cooperation agreement on zebruch Wharf in Belgium. According to the agreement, CNOOC terminal development (Hong Kong) Co., Ltd., a subsidiary of CNOOC Group, acquired 24% of the equity of zebruhe terminal company held by apmt, a subsidiary of Maersk Group.

Europe	Ukraine	Infrastructure investment	In 2018, China Bay won the bid to construct the dredging project of Ukraine's black harbor.
	Greece	Equity control	In 2008,COSCO Shipping obtains 50 years' operation right of Piraeus port in Greece.
	Spain	Equity control	In 2017,COSCO Shipping acquired 51% of the equity of Spain's naotum port.
	Netherlands	Port Alliance	In 2015, Guangxi Beibu Gulf port and basheng port became friendly ports.
Southeast Asia	Malaysia	Port Alliance	In 2015, Shenzhen port and basheng port became friendly ports.
		Port Alliance	In 2013, Guangxi Beibu Gulf officially participated in the construction of Guandan port in Malaysia.
Southeast Asia	Indonesia	Infrastructure investment	In 2016, Hebei Port invested in Indonesia Zhanbi Iron and Steel Industrial Park International Port Project.
	Singapore	Investment and equity participation	Cosco Pacific and PSA formed Cosco Newport Terminals (CPT) in 2003 to jointly operate two berths at the Singapore terminal, with 49 per cent and 51 per cent stakes respectively. It is the first successful investment in a terminal project outside China.

Southeast Asia		Investment in port construction	On January 17, 2019, COSCO Marine Ports Co., Ltd. and PSA PSA officially held a signing ceremony for the addition of two berths at Singapore COSCO Newport Terminal in Boao, Hainan.
	Thailand	Port Alliance	In 2015, Guangzhou Port and Lin Chaban Port signed a letter of intent to establish a sister port.
	Cambodia	Port Alliance	In 2015, Qingdao Port and Sinuhak Port signed the Friendship Port Agreement.
	Myanmar	Port Alliance	In 2015, Qingdao Port and Kyaukpyu Port signed the Friendship Port Agreement.
		Investment in port construction	In 2018, China and Myanmar officially signed the Kyaukpyu deep-water port project agreement.

2.3 Typical cases of China-foreign cooperative ports

2.3.1 Piraeus Port

Piraeus port is located on the northeast coast of saronicos Bay, the southeast coast of Greece, on the southwest side of the Aegean Sea. In 2010, the Greek debt crisis broke out, and all major industries were greatly impacted. COSCO Shipping took over the operation of bigang container terminals 2 and 3 through franchise. In 2016, COSCO Shipping completed the acquisition of 67% shares of Piraeus Port Authority (PPA), becoming the operator of the whole port. Through the introduction of advanced management technology and experience, the container business has been greatly increased, and the operation efficiency has been improved. Up to now, COSCO Shipping has created more than 3000 jobs directly and more than 10000 indirectly in Greece, contributing 300 million euros to the local economy every year. Driven by the belt and road initiative, Piraeus port has become one of the fastest growing container

ports in the world. The container throughput has increased from 880 thousand standard containers in 2010 to the 5 million 800 thousand standard boxes this year. The ranking of the container ports in the world has jumped to thirty-second from the ninety-third place that China took over.[28]

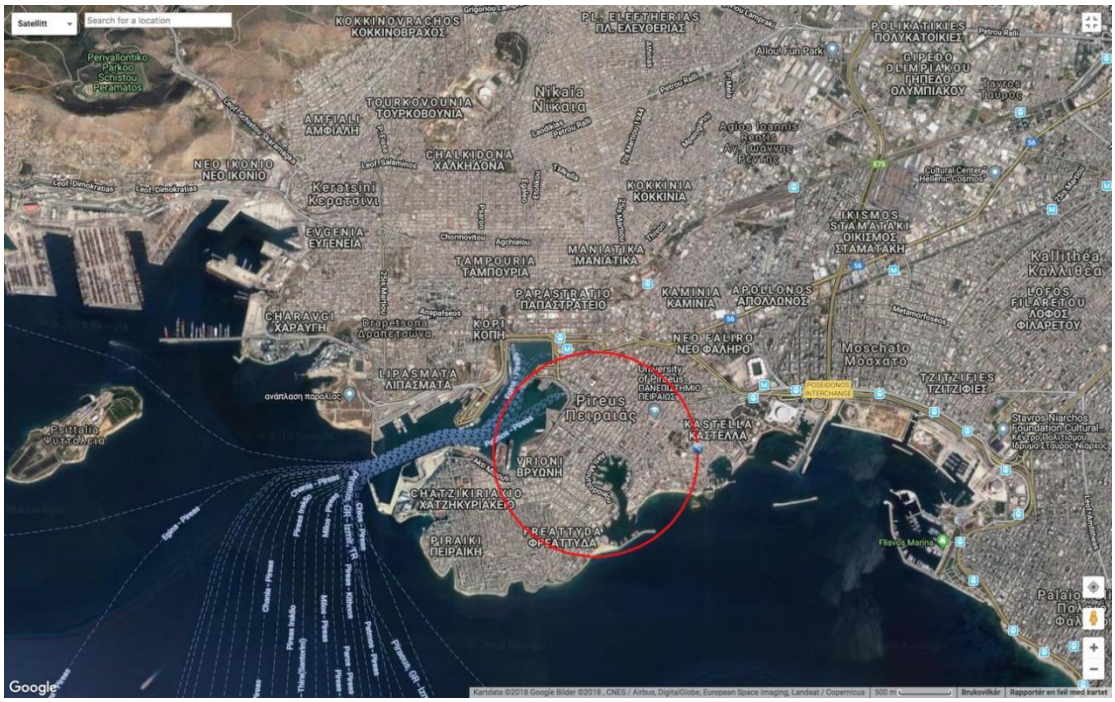

Figure2-2:Location of Piraeus port

2.3.2 Djibouti port

Djibouti port is a free port of the Republic of Djiboutian in East Africa and a transit port in Ethiopia. It is located at the entrance of the South Bank of tajura Bay on the southeast coast of Djibouti, close to the southwest side of the Gulf of Aden. It is the largest seaport of Djibouti and one of the largest modern ports in East Africa. On August 17, 2014, China Civil Engineering Group Co., Ltd. and China Construction Group Co., Ltd. jointly won the bid to start the phase I project of doralei multi-functional Wharf at the port of Djibouti, with a construction period of 30 months, including a 1200 meter long wharf shoreline with five multi-purpose deep-water berths, a 175 meter long service berth and related supporting facilities. The project adopts the "design and construction general contracting" mode. After completion, the logistics capacity of the port will be greatly enhanced, not only the import and export to Ethiopia, but also the transit capacity to surrounding countries,

which will greatly drive the economy and employment of this country.[29]

Figure2-3:Location of Djibouti port

2.3.3 Hanbantota port

Hanbantota deep water port is located in the capital of hanbantota District, southern province of Sri Lanka. Hanbantota port has been under construction since 2007 with the assistance of China and has been in operation since 2012. In July 2017, Sri Lanka signed an agreement with China. China Merchants holding Port Co., Ltd. acquired 70% of the equity of hanbantota port and leased the port and surrounding land for 99 years. On December 9, 2017, the Sri Lankan government will formally transfer the assets and management rights of hanbantota port in the south of Sri Lanka to China Merchants Group. Hanbantota port is the key point of cooperation between China and Sri Lanka, which has a demonstration effect for China to promote the port construction of "21st century Maritime Silk Road".

Figure2-4:Location of Hanbantota port

2.3.4 Gwadar port

Gwadar Port is an important port in Pakistan, located in the southwest of Pakistan, at the mouth of the Strait of Hormuz. Gwadar deep water port is the third largest port in Pakistan, with deep water and close to the main channel. In 2002, Chinese port enterprises began to invest in the construction of Gwadar Port. In 2013, China officially took over the operation right of Gwadar Port. In 2015, Gwadar Port officially opened for operation, and Chinese enterprises obtained the operation right for 40 years. The opening and operation of Gwadar Port plays an important role in promoting the construction and layout of the 21st century Maritime Silk Road in the region.

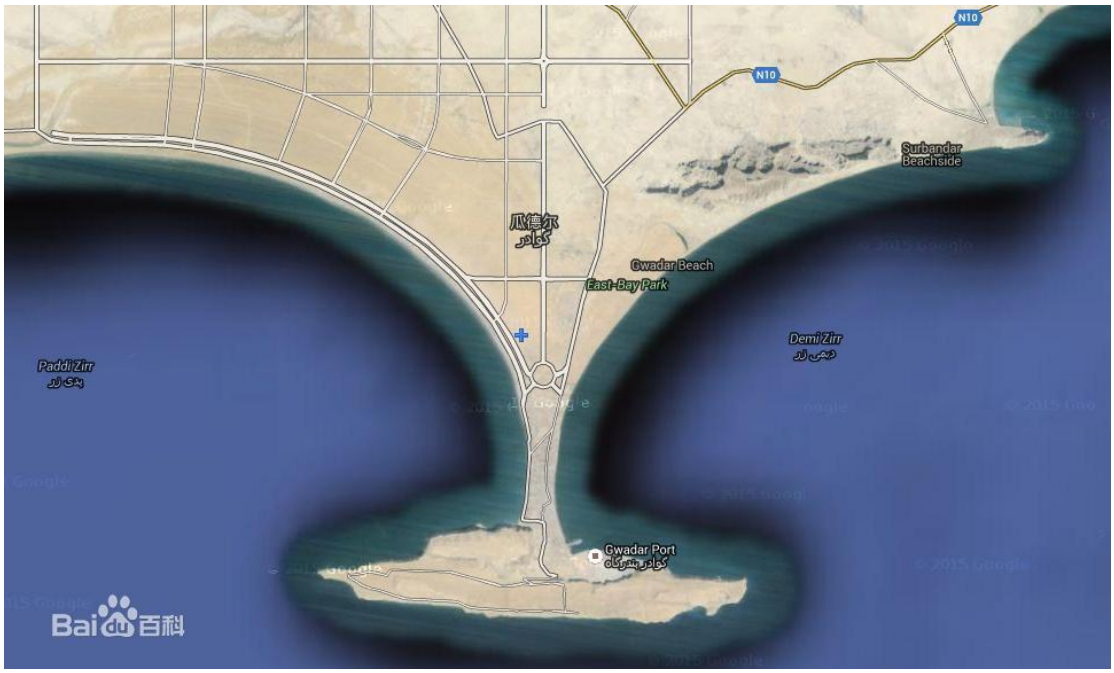

Figure2-5:Location of Gwadar port

It can be seen from these cases of China-foreign cooperation that most of the projects are investment in port construction, and the geographical location of the port is very prominent. It is located in the straits and estuary of various regions. The scale of the port is in the forefront of the host country, and it has a good infrastructure and economic environment.

2.4 Overview of port data of the 21st Century Maritime Silk Road

2.4.1 Liner transport efficiency level

LSCI is the liner transport correlation index published by the United Nations Conference on Trade Development (UNCTAD). The index can directly reflect the connection between a country's ports and global ports. The index ranges from 1-170, and the higher the index, the closer the shipping network of the country's ports is with the world.

The following table lists the LSCI indices for countries in each region from 2012 to 2018.

Table 2:LSCI index（China and Southeast Asia）

Countries Year	China	Malaysia	Thailand	Cambodia	Singapore	Myanmar
2012	156.19	99.69	37.66	3.45	113.16	4.20

2013	157.51	98.18	38.32	5.34	106.91	6.00
2014	165.05	104.02	44.88	5.55	113.16	6.25
2015	167.13	110.58	44.43	6.69	117.13	6.23
2016	169.20	108.88	46.39	8.63	118.47	10.03
2017	169.56	104.80	44.59	8.66	121.63	7.35
2018	151.91	109.86	47.95	9.29	133.92	9.29

Source:UNCTAD database.

Table 2 shows that the LSCI index of Southeast Asian countries and China has been on the rise year by year since 2012, with China ranking the first place all year round, followed by Malaysia and Singapore. The reason why the LSCI index of these two countries is always high is that both Malaysia and Singapore belong to the Strait of Malacca, which is an important channel between the Indian Ocean and the Pacific Ocean, as well as an important channel for oil from West Asia to East Asia. It accounts for between a fifth and a quarter of the world's seaborn trade, and a quarter of the world's oil tankers pass through the Strait of Malacca. Both Cambodia and Myanmar scored less than a tenth of the LSCI in 2018 than the first three countries in 2012, partly because of their geographical location and partly because of their politics. In general, the LSCI index in this region showed a slow upward trend from 2012 to 2018, with a growth rate of 11.55%. However, there is still a large gap between the LSCI indexes of different countries.

Table 3:LSCI index（Middle East）

Countries Year	**Turkey**	**Iran**	**Qatar**	**Saudi Arabia**	**United Arab emirates**
2012	53.15	22.62	6.53	60.40	61.09
2013	52.13	21.30	3.35	59.67	66.97

2014	52.37	5.85	3.86	61.25	66.48
2015	51.97	11.91	5.20	64.83	70.40
2016	56.46	33.16	7.18	60.66	72.22
2017	56.13	40.63	31.46	61.99	67.86
2018	59.69	42.47	41.69	66.62	72.87

Source:UNCTAD database.

From 2012 to 2018, the top three countries in the LSCI index have been the United Arab Emirates, Saudi Arabia and Turkey, among which the United Arab Emirates scored 72.87 in 2018, ranking the highest in the region, reflecting the good port network accessibility of the United Arab Emirates and the high level of port connectivity with the world. It is worth noting that the LSCI index of Iran fell from 21.30 in 2013 to 11.91 in 2015, largely because the country was subject to a large extent of international political fluctuations, so the investment in ports should also take into account the future political changes. On the whole, the LSCI index of all the countries in this region has improved to a certain extent, but the rising speed is relatively slow, which is a big gap with that of Southeast Asia.

Table 4:LSCI index（South Asia）

Countries **Year**	**Bangladesh**	**Pakistan**	**Sri Lanka**
2012	8.02	28.12	43.43
2013	7.96	27.71	43.01
2014	8.40	27.50	53.04
2015	9.31	32.33	54.43
2016	10.95	34.82	61.21
2017	11.87	34.86	70.62
2018	12.07	38.20	72.46

Source:UNCTAD database.

In South Asia, Sri Lanka's LSCI index has been at a high level from 2012 to 2018 and has been rising rapidly, from 43.43 in 2012 to 72.46 in 2018, with a year-on-year

growth of 66.8%. This is closely related to China's participation in the investment and cooperation of Sri Lanka's ports. Bangladesh and Pakistan showed a small increase but little change. The LSCI development was slow, and the reasons were related to the geographical location and political turbulence.

Table 5:LSCI index（Europe）

Countries Year	Ukraine	Spain	Italy	Greek	Netherlands
2012	24.47	74.44	66.33	45.50	88.93
2013	26.72	70.44	67.26	45.35	87.46
2014	27.72	70.80	67.58	47.25	94.15
2015	30.06	84.89	67.43	46.81	96.33
2016	28.30	80.21	65.54	49.76	89.88
2017	27.62	88.01	66.07	51.56	90.63
2018	30.15	90.11	67.22	69.41	98.00

Source:UNCTAD database.

Europe's LSCI index is higher compared to other regions. The Netherlands has consistently had the highest LSCI index from 2012 to 2018, with 88.93 in 2012 and 98.00 in 2018. Spain was second, with an LSCI index of 90.11 for 2018. The lowest LSCI is Ukraine, with 30.15 in 2018. The reasons are related to the country's economy and geographical location. In general, the European region shows a slow upward trend and the LSCI index has been at a high level in the world.

Table 6:LSCI index（Africa）

Countries Year	Nigeria	Algeria	Libya	Egypt
2012	21.81	7.80	7.51	57.39
2013	21.35	6.91	7.29	57.48
2014	22.91	6.94	6.82	61.76
2015	21.44	5.92	5.93	61.45

2016	20.85	10.47	6.41	62.30
2017	20.53	8.80	8.39	58.65
2018	18.96	10.36	11.71	70.28

Source:UNCTAD database.

Table 6 shows LSCI index of Africa.It is obvious that the LSCI index in Africa is very low, and there are huge differences between countries. Egypt's LSCI index has been the highest since 2012, increasing by nearly 35.54% from 57.39 in 2012 to 70.28 in 2018. However, the other three countries, especially Libya, have been among the world's lowest in the LSCI index over the past six years, or even showed a downward trend. Libya's low LSCI index is due to the impact of political unrest in the country and the severe damage to its infrastructure. On the whole, the LSCI index score of this region is low, which is related to the backward port infrastructure and small foreign trade volume of countries in Africa.

2.4.2 Container throughput of countries along the maritime Silk Road in the 21st century

Container throughput refers to the sum of the number of imported and exported containers in a certain port over a period of time, usually in TEU. Container throughput reflects the role of a port in domestic material exchange and foreign trade transportation, and is also the basis of port planning and capital construction. Generally speaking, large container throughput ports, busy trade, port prosperity, in the more important position of maritime trade.Based on the world bank database, this paper collects the container throughput of the countries related to the above LSCI index from 2012 to 2018, which is divided into five parts: Southeast Asia, Middle East, South Asia, Europe and Africa.

Table 7:Container throughput（China and Southeast Asia）

Countries Year	**China**	**Malaysia**	**Thailand**	**Cambodia**	**Singapore**	**Myanmar**
2012	166510000	20890000	8410000	220000	32340000	1420000
2013	175930000	21370000	8900000	230000	33390000	1490000

2014	186680000	22640000	9420000	340000	34690000	1640000
2015	195270000	24250000	9520000	390000	31710000	2040000
2016	199550000	24570000	9950000	400000	32670000	2370000
2017	213710000	24710000	10730000	490000	33600000	2580000
2018	225830000	24960000	11190000	740000	36600000	1290000

Source:World Bank Database;The unit is "TEU"

Table 7 shows that from 2012 to 2018, China's container throughput has been in the absolute leading position, reaching 225.83 million TEU in 2018. Apart from China, Malaysia and Singapore are among the top in container throughput, mainly due to their natural geographical advantage -- the Strait of Malacca, the world's busiest shipping "channel", is a veritable "lifeline of the sea". The container throughput of other countries is at a low level, which is not only due to geographical factors, but also related to the country's own low economic trade.

Table 8:Container throughput（Middle East）

Countries Year	**Turkey**	**Iran**	**Qatar**	**Saudi Arabia**	**United Arab emirates**
2012	8170000	2660000	420000	7950000	18120000
2013	9430000	2130000	420000	7810000	18690000
2014	9340000	2270000	460000	7440000	20220000
2015	8830000	2160000	570000	7570000	21230000
2016	8580000	2560000	570000	7590000	20610000
2017	9920000	3090000	1270000	8400000	21280000
2018	9940000	3790000	1840000	8670000	19050000

Source:World Bank Database;The unit is "TEU"

Table 8 shows that in the Middle East, the container throughput of the United Arab Emirates has been at the first place among the five countries in the Middle East since 2012, from 18.12 million TEU in 2012 to 19.05 million TEU in 2018. The reason is that the United Arab Emirates has perfect infrastructure (15 ports, 308 docks) are directly related. Turkey and Saudi Arabia are next, which is related to the country's

geographical location and resource exports. In general, the container throughput of ports in various countries increased slowly but changed little from 2012 to 2018.

Table 9:Container throughput（South Asia）

Countries Year	Bangladesh	Pakistan	Sri Lanka
2012	1420000	2220000	4320000
2013	1480000	2260000	4310000
2014	1640000	2530000	4900000
2015	2040000	2750000	5180000
2016	2370000	2750000	5550000
2017	2580000	2980000	6000000
2018	2830000	3280000	7000000

Source:World Bank Database;The unit is "TEU"

Table 9 shows that the container throughput in South Asia is low. Sri Lanka has always maintained the first position from 4.32 million TEU in 2012 to 7.00 million TEU in 2018, far exceeding Pakistan and Bangladesh. This is related to the foreign investment in the infrastructure of Colombo Port and Hambantota Port of Sri Lanka. The cooperation project of Colombo Port between China and Sri Lanka has greatly improved the port infrastructure level of Sri Lanka. Generally speaking, the ports of South Asian countries do not have an advantage in container throughput.

Table 10:Container throughput（Europe）

Countries Year	Ukraine	Spain	Italy	Greek	Netherlands
2012	810000	14040000	9080000	3050000	12100000
2013	780000	13890000	10170000	3480000	11800000
2014	660000	14210000	10240000	3930000	12470000
2015	470000	14270000	10010000	3670000	12400000
2016	580000	15260000	10260000	4050000	12650000
2017	620000	17060000	10690000	4460000	13950000

2018	1180000	17190000	12700000	5320000	14830000

Source:World Bank Database;The unit is "TEU"

Table 10 shows that in the European region, Spain has the largest container throughput, reaching 17.19 million TEU in 2018, and has maintained the highest level in the region from 2012 to 2018, followed by the Netherlands and Italy. It is worth noting that the container throughput of Ukraine and Greece is much smaller than that of other countries. The main reason is the economic downturn of the countries, the most direct manifestation of which is the Greek economic crisis in 2012. On the whole, the container throughput in Europe is at the world's medium level, and there is a slow rising trend.

Table 11:Container throughput（Africa）

Countries Year	**Nigeria**	**Algeria**	**Libya**	**Egypt**
2012	1720000	1080000	490000	7430000
2013	1580000	1140000	430000	7350000
2014	1700000	1240000	460000	7900000
2015	1400000	1240000	460000	7190000
2016	1430000	1250000	450000	7380000
2017	1650000	1400000	470000	7430000
2018	1210000	1470000	90000	7470000

Source:World Bank Database;The unit is "TEU"

Table 11 shows the container throughput of the African region, in which Egypt's container throughput remained the first in the region from 7.43 million TEU in 2012 to 7.47 million TEU in 2018, but the container throughput barely changed. Other countries' throughput is at a very low level, with Libya only 0.09 million TEU in 2018. Egypt's high container throughput is closely related to its geographical advantages and economic development. The Suez Canal, which connects the Mediterranean and the Red Sea, provides the closest shipping route from Europe to the land around the Indian Ocean and the Western Pacific, and is one of the busiest shipping routes in the

world. The low container throughput in Libya is directly related to its political turmoil and war, and the country's foreign trade is depressed.

In the five regions listed in this paper, a total of 22 regions, we can find three factors that affect the national container throughput: geographical factors, economic factors, political factors.

Singapore, Malaysia and Egypt are the three countries that can best reflect the benefits brought by geographical factors. Although these three countries are all developing countries and their economies are not very developed, because Singapore and Malaysia are near the Strait of Malacca, a large number of international trade flows through the nearby ports; Egypt administers the Suez Canal, which connects the Mediterranean Sea with the Red Sea and provides the nearest route from Europe to the land near the Indian Ocean and the Western Pacific Ocean. It is one of the busiest routes in international trade. Therefore, the container throughput of these three countries is higher than that of other countries in the same region due to their geographical advantages.

The United Arab Emirates, Saudi Arabia and European countries can best reflect the benefits brought by economic factors. The high container throughput of UAE and Saudi Arabia is closely related to their foreign oil trade. Most of the world's oil is imported from the Middle East. European countries are all developed countries, with high level of economic development, perfect port facilities and busy foreign trade, and higher container throughput than other countries.

Iran, Syria and other countries can best reflect the political factors. Because of the long-term impact of international sanctions and war, their countries' economic downturn and infrastructure have been seriously damaged, resulting in extremely low container throughput. On the contrary, if a country is politically stable, it can better develop foreign trade and improve port container throughput.

2.4.3 Port infrastructure efficiency level

The efficiency level of port infrastructure is a parameter to measure the various hardware equipment of the port. It is based on the integrated score of the number of port berths and the depth of the waterway. This article collects the port infrastructure

level index of the above 22 countries from 2012 to 2018. The port infrastructure level index ranges from 1-7. The higher the score, the better the port infrastructure.

Table 12:Port infrastructure efficiency level（China and Southeast Asia）

Countries Year	China	Malaysia	Thailand	Cambodia	Singapore	Myanmar
2012	4.40	5.50	4.60	4.24	6.80	2.80
2013	4.50	5.40	4.50	4.25	6.80	2.90
2014	4.60	5.60	4.50	3.63	6.70	3.00
2015	4.55	5.57	4.49	3.78	6.67	3.10
2016	4.50	5.60	4.50	3.81	6.70	3.20
2017	4.60	5.40	4.30	3.91	6.70	3.30
2018	4.70	5.50	4.40	4.50	6.70	4.00

Source:World Bank Database;The score range is 1-7.

Table 12 shows that Singapore's port infrastructure level has been the highest in Central and South Asia since 2012, and it was 6.70 in 2018. This is followed by Malaysia, which scored 5.50 in 2018. The reason is that these two countries are located in the Straits of Malacca, one of the busiest shipping areas in the world, with developed port transit trade and a relatively high level of port infrastructure. Although the level of port infrastructure in other countries is lower than that of Singapore and Malaysia, it is still above the average. Generally speaking, the level of port infrastructure in each country has increased in six years.

Table 13:Port infrastructure efficiency level（Middle East）

Countries Year	Turkey	Iran	Qatar	Saudi Arabia	United Arab emirates
2012	4.40	4.00	5.20	5.30	6.40
2013	4.30	4.10	5.20	5.10	6.40
2014	4.40	4.00	5.40	5.00	6.50
2015	4.488	3.90	5.60	4.84	6.47

2016	4.50	3.90	5.60	4.80	6.50
2017	4.50	4.00	5.60	4.70	6.20
2018	4.60	4.11	5.70	4.75	6.30

Source:World Bank Database;The score range is 1-7.

Table 13 shows the port infrastructure level index of countries in the Middle East. The country with the highest score is the United Arab Emirates, which reached 6.30 points in 2018. The country with the lowest score is Iran, with a score of 4.11 in 2018, which is lower than the average of 5.09 for the year. The UAE's highly developed oil trade has made the country's port infrastructure relatively high, while Iran's long-term international trade sanctions have limited international trade cooperation and the development of port infrastructure has been slow. In general, from 2012 to 2018, the level of port infrastructure in the Middle East countries has improved to a certain extent, but has not changed much.

Table 14:Port infrastructure efficiency level（South Asia）

Countries Year	**Bangladesh**	**Pakistan**	**Sri Lanka**
2012	3.39	4.45	4.90
2013	3.59	4.56	4.20
2014	3.79	4.48	4.20
2015	3.59	4.08	4.27
2016	3.69	4.19	4.30
2017	3.69	4.76	4.50
2018	3.70	4.81	4.60

Source:World Bank Database;The score range is 1-7.

Table 14 shows the development status of port infrastructure in South Asia. On the whole, the port infrastructure development of countries in the region is lower than that of other regions. The highest country is Pakistan, which was only 4.81 points in 2018.

Table 15:Port infrastructure efficiency level（Europe）

Countries Year	Ukraine	Spain	Italy	Greek	Netherlands
2012	4.00	5.80	3.90	4.20	6.80
2013	3.70	5.80	4.30	4.50	6.80
2014	3.30	5.80	4.50	4.70	6.80
2015	3.16	5.65	4.32	4.59	6.77
2016	3.20	5.70	4.30	4.60	6.80
2017	3.50	5.10	4.40	4.50	6.80
2018	3.50	5.22	4.55	4.71	6.80

Source:World Bank Database;The score range is 1-7.

Table 15 shows the level of port infrastructure development in Europe. From 2012 to 2018, the Netherlands and Spain maintained a relatively high level. Especially in the Netherlands, it reached 6.80 points close to 7.0 in 2018. The main reason is the port of Rotterdam in the Netherlands. The port of Rotterdam is a world-famous port. The container throughput has always been at the forefront of the world and has complete port operation facilities. On the whole, the level of port infrastructure in European countries is in the forefront of the world, which is directly related to their being developed countries and their high economic level.

Table 16:Port infrastructure efficiency level（Africa）

Countries Year	Nigeria	Algeria	Libya	Egypt
2012	3.60	3.12	3.50	4.00
2013	3.40	2.70	3.00	4.10
2014	3.20	2.80	2.60	4.20
2015	2.98	2.98	2.70	4.32
2016	3.00	3.00	3.00	4.30
2017	2.80	3.40	3.30	4.70

2018	2.90	3.20	3.15	4.50

Source:World Bank Database;The score range is 1-7.

Table 16 shows the development level of port infrastructure in Africa. In 2012, the average score of this region was 3.56 points, and the average score in 2018 was 3.44 points. It is the region with the worst level of port infrastructure development among the five regions. The country is a developing country with a backward economy and low trade volume, which is directly related to the incomplete infrastructure. Egypt is the country with the best level of port infrastructure development among African countries, with a score of 4.50 in 2018, which is inseparable from Egypt's management of the Suez Canal. Generally speaking, there is still a lot of room for improvement in the development level of port infrastructure in Africa.

Chapter3：Research on Investment value Evaluation Based on Principal Component Analysis

This chapter uses the principal component analysis method to select four sub-projects to carry out a quantitative calculation of the Investment value of the ports in each region, and compare them.

3.1 Construction of index system of port Investment value

3.1.1 Influencing factors of port Investment value

There are many factors that affect the Investment value of ports. From the three aspects of the port analysis above, we can divide the influencing factors into three categories: port infrastructure level, geographic location, and hinterland economy.

(1)Port infrastructure level

The port logistics infrastructure refers to the facilities that must be equipped to complete the most basic functions of port logistics. Generally include port waterways, breakwaters, anchorages, wharves, berths, port traffic and supporting facilities, etc. The better the infrastructure, the more efficient the port operation. Port channel refers to that in order to ensure that ships can enter and leave the port safely and conveniently, there must be sufficient water depth and a certain width channel in the port. The deeper the port channel, the larger the tonnage of large ships that can be docked. [30]Port berth refers to the length of the shoreline occupied by a design standard ship docking at the dock or the number of hoarded ships occupied. The number of port berths directly affects the efficiency of port handling operations. A wharf refers to a hydraulic structure for ships to dock, load and unload cargo, and to get on and off tourists. The professional wharf is equipped with high-efficiency special machinery and equipment to load and unload bulk cargo with large volume and stable flow, such as oil wharf, coal wharf, ore wharf, etc. Professional terminals also directly affect the efficiency of port loading and unloading operations.

(2)geographic location

The geographical location of a country has a great impact on the Investment value of ports in the region. Specifically, it can be divided into two aspects: whether the ports of the country are close to the main waterway and whether the country has scarce energy exports. As mentioned above, Singapore and Malaysia are among the world's top in port infrastructure efficiency, container throughput and LSCI index, largely due to the proximity of their ports to the Strait of Malacca, which is one of the busiest trade routes in the world. Egypt's location on the Suez Canal is also the most important reason why it outperforms other countries in various indicators. The biggest advantage of the UAE and Saudi Arabia is the export of oil, a rare source of energy. The large volume of oil imports and exports has given the region's ports rapid development and important geographical location.[31] Therefore, geographical factors should be taken into consideration when considering the Investment value of ports.

(3)Hinterland economy

The economic development level of port hinterland includes social factors such as the economic development level of port location, total population and market environment. Port hinterland economic development level had a greater influence on the Investment value of port, such as Spain, the Netherlands, European developed countries the region economy development, active development level is high, the transportation network is perfect, import and export trade volume is high, the total amount of foreign investment is higher, the driving force to promote the development of port hinterland economy will greatly improve the Investment value of the port.

3.1.2 Principles for Constructing the Evaluation Index System of Port Investment value

(1)Scientific principle

The construction of the port's Investment value evaluation index system first follows the scientific principle. The selection of evaluation indicators must scientifically reflect the objective characteristics and representativeness of the evaluation object. There are many factors that affect the Investment value of a port, but it is necessary to select indicators that can comprehensively measure the characteristics of port competitiveness based on a scientific and objective perspective, and to follow the

quantification of indicator data.

(2)Systemic principle

The Investment value of a port is a systematic concept, involving all aspects of the port, and the selected indicators should systematically reflect the characteristics of the port's Investment value. The factors affecting the Investment value of the port sub-committee the port itself and its peripheral conditions The port's own factors include port hardware infrastructure and port management; the port's peripheral factors include the economic development level of the port hinterland.

(3)Practicality principle

The practicality principle of data requires that the data be widely used and have the characteristics of easy operation and feasible operation, so that it can guide practical activities. When evaluating similar evaluation objects, it should be easy to use directly, making the evaluation index system more practical.

3.1.3 Port Investment value evaluation system

The Investment value of a port is a systematic concept, which is the ability of a port to bring economic benefits or geographic advantages to investors in the process of production and operation. The factors affecting the Investment value of the port are divided into internal factors and external factors. The internal factors mainly include port container throughput, port infrastructure level index, and liner linear transportation index. The external factor is mainly the economic situation of the port country, that is, the GDP of the host country.According to the construction principles of the port Investment value evaluation index system and the availability and completeness of data, this paper establishes the 21st century Maritime Silk Road Investment value evaluation index system for major countries’ ports, and estimates 23 ports along the Maritime Silk Road from 2012 to 2018. The Investment value of the country’s ports.

Table 17: The 21st Century Maritime Silk Road Port Investment value Evaluation System

Target	First-level index	Secondary indicators
Port Investment value	Port capacity	Container throughput
	Hardware capability	Port Infrastructure Level Index
		Liner Linear Transportation Index
	Port hinterland economy	GDP of host country

Based on three first level indicators and four second level indicators, this paper constructs the evaluation index system of Investment value of ports along the 21st century Maritime Silk Road. There are three primary indicators: port capacity, hardware capacity and port inland economy. The secondary indicators are container throughput, port infrastructure level index, linear transportation index and GDP of host country.

3.2 An overview of principal component analysis

The principle of principal component analysis is to try to recombine the original variables into a group of new independent comprehensive variables. At the same time, according to the actual needs, a few less total variables can be taken out to reflect the information of the original variables as much as possible. This statistical method is called principal component analysis or principal component analysis, and it is also a mathematical method of dimension reduction. Principal component analysis (PCA) is to try to replace the original indicators by a new set of unrelated comprehensive indicators, which have a certain correlation (such as P indicators). Usually, the mathematical treatment is to make a linear combination of the original P indexes as a new comprehensive index. The most classic way is to use the variance of F1 (the first selected linear combination, that is, the first comprehensive index) to express, that is, the larger VA (RF1), the more information F1 contains. Therefore, among all the

linear combinations, F1 should be the one with the largest variance, so F1 is called the first principal component. If the first principal component is not enough to represent the information of the original P indicators, then consider selecting F2, that is, selecting the second linear combination. In order to effectively reflect the original information, the existing information of F1 does not need to appear again. In F2, the expression in mathematical language requires cov (F1, F2) = 0, then F2 is called the second principal component, and so on, the third, fourth, The p-th principal component.[32]

3.3 Port Investment value based on principal component analysis

3.3.1 Original data of evaluation index

This paper selects 4 secondary indicators to measure the Investment value of ports of countries along the Maritime Silk Road in the 21st century. The data sources are shown in Table 18.

Table 18: Data sources of port Investment value evaluation index system

Variable name	Code	Unit	Data sources
Port infrastructure level index	X1	1-7	World Bank Database
Port Container Throughput	X2	TEU/million	World Bank Database
Liner linear transport index	X3	1-170	UNCTAD
GDP of host country	X4	Hundred Million US Dollars	World Bank Database

Based on the different data units of each evaluation index and the different sizes of data dimensions, in order to reduce the impact of dimensions on data statistics, this paper uses SPSS25.0 to standardize the original data. Table 19 is the raw data of 2018.Table 20 is the standardized data of the 2018 data.

Table 19:Raw data

	ZX1	ZX2	ZX3	ZX4
Malaysia	5.5	25.0	109.9	3543.5
Thailand	4.4	11.2	48.0	5065.1
Cambodia	4.5	0.7	9.3	245.7
Singapore	6.7	36.6	133.9	3732.1
Myanmar	4.0	1.3	9.3	761.6
Turkey	4.6	9.9	59.7	7783.8
Iran	4.1	3.8	42.5	4539.9
Qatar	5.7	1.8	41.7	1833.3
Saudi Arabia	4.8	8.7	66.6	7865.2
United Arab emirates	6.3	19.1	72.9	4222.1
Bangladesh	3.7	2.8	12.1	2740.3
Pakistan	4.8	3.3	38.2	3145.6
Sri Lanka	4.6	7.0	72.5	884.2
Ukraine	3.5	1.2	30.2	1309.0
Spain	5.2	17.2	90.1	14220.0
Italy	4.6	12.7	67.2	20920.0
Greek	4.7	5.3	69.4	2181.3
Netherlands	6.8	14.8	98.0	9140.4
Nigeria	2.9	1.2	19.0	3971.9
Algeria	3.2	1.5	10.4	1754.0
Libya	3.2	0.1	11.7	526.0
Egypt	4.5	7.5	70.3	2497.1

Table 20:Standardized data

Malaysia	**ZX1**	**ZX2**	**ZX3**	**ZX4**
Thailand	.79583	1.75439	1.59062	-.23005
Cambodia	-.22859	.26349	-.16453	.07892

Singapore	-.13546	-.86794	-1.26055	-.89968
Myanmar	1.91339	3.01467	2.27272	-.19176
Turkey	-.60111	-.80839	-1.26055	-.79493
Iran	-.04233	.12815	.16830	.63096
Qatar	-.49867	-.53771	-.31989	-.02773
Saudi Arabia	.98209	-.74884	-.34201	-.57731
United Arab emirates	.09736	-.00935	.36476	.64749
Bangladesh	1.54087	1.11451	.54195	-.09226
Pakistan	-.88050	-.64166	-1.18174	-.39314
Sri Lanka	.15324	-.59293	-.44095	-.31085
Ukraine	-.04233	-.19016	.53033	-.77003
Spain	-1.06676	-.82030	-.66917	-.68378
Italy	.53507	.91312	1.03071	1.93785
Greek	-.08890	.42698	.38177	3.29831
Netherlands	.06011	-.37206	.44386	-.50665
Nigeria	2.00652	.65760	1.25439	.90642
Algeria	-1.62553	-.81705	-.98640	-.14306
Libya	-1.34615	-.78890	-1.23021	-.59342
Egypt	-1.39271	-.93832	-1.19194	-.84277
Malaysia	-.13546	-.13928	.46852	-.44253

3.3.2 Principal component analysis possibility test

Since not all samples and data are suitable for principal component analysis, correlation and validity tests must be carried out before principal component analysis. Data of the four evaluation indexes are input into SPSS25.0 for correlation coefficient matrix analysis and KMO and Bartlett tests, and the results are as follows:

Table 21:Variable correlation matrix table

	ZX1	**ZX2**	**ZX3**	**ZX4**

ZX1	1.000	0.751	0.802	0.249
ZX2	0.751	1.000	0.896	0.354
ZX3	0.802	0.896	1.000	0.396
ZX4	0.249	0.354	0.396	1.000

From the perspective of correlation matrix, the correlation coefficient between X1 port infrastructure level index, X2 port container throughput and X3 liner liner linear transport index is greater than 0.55, showing a strong correlation between variables. There is a certain relationship between GDP of the country where variable X4 is located and X1, X2 and X3. In general, the correlation coefficients among all variables are large, and the information overlap may be relatively high.

Table 22:KMO and Bartlett tests

KMO		0.744
Bartlett tests	The approximate chi-square	53.857
	Degrees of freedom	6.000
	Significant	0.000

According to KMO and Bartlett sphericity test, the KMO Investment value is 0.744, which is greater than 0.5, and the surface variables are suitable for principal component analysis. The significance of SIG is less than 0.005, indicating that the data of sample variables are derived from normal distribution. In general, the setting of variables is suitable for principal component analysis.

3.3.3 Identify and interpret principal components

Input the data into SPSS25.0 for principal component analysis, extract common factors, and obtain the results 3-8 total variance interpretation table. The first principal component eigenInvestment value is 2.819, explaining 70.48% of the total variance, indicating that this is a maximum factor; the second principal component initial eigenInvestment value is 0.829, explaining 20.723% of the total variance. The total

variance of the two principal components accumulates 91.203%, higher than the standard of 85%.

Table 23:The interpretation of the total variance

Initial Eigenvalues				The sum of squares of the extraction load		
Composition	Total	Percentage of variance	Cumulative percentage	Total	Percentage of variance	Cumulative percentage
1	2.819	70.480	70.480	2.819	70.480	70.480
2	0.829	20.723	91.203	0.829	20.723	91.203
3	0.256	6.405	97.608			
4	0.096	2.392	100.000			

Extraction method: principal component analysis

Table 24:The composition matrix after rotation

	Component 1	**Component 2**
X1	0.914	0.064
X2	0.917	0.214
X3	0.929	0.251
X4	0.174	0.982

Extraction method: principal component analysis

Table 25:Component score coefficient matrix

	Component 1	**Component 2**
X1	0.404	-0.188
X2	0.363	-0.023
X3	0.358	0.015
X4	-0.197	1.031

Extraction method: principal component analysis

Table 24 is the matrix table of principal component load. The first principal component has a large load on the variables X1 port basic level index, X2 port container throughput and X3 liner linear transport index. The second principal

component has a higher load on the GDP of the country where variable X4 is located.

3.3.4 Principal component calculation and score

(1)Calculation of eigenvectors

$$eij = \frac{aij}{\sqrt{\lambda i}}$$

Aij represents the load coefficient of the JTH variable in the principal component load matrix in the ith principal component before rotation: Eij represents the Investment value corresponding to the normalized orthogonal vector. According to the factor loading matrix, the first principal component Initial Eigenvalue is 2.819, and the second principal component Initial Eigenvalue is 0.829. The corresponding standard orthogonalized feature vectors are shown in Table 26:

Table 26:Normalized eigenvector matrices

	Component 1	**Component 2**
X1	0.240	-0.206
X2	0.216	-0.025
X3	0.213	0.016
X4	-0.117	1.132

So we can get two principal component score functions:

$$F1 = 0.240ZX1 + 0.216ZX2 + 0.213ZX3 - 0.117ZX4$$

$$F2 = -0.206ZX1 - 0.025ZX2 + 0.016ZX3 + 1.132ZX4$$

F1 and F2 represent the first and second principal components of the Investment value of ports along the 21st Century Maritime Silk Road: ZX1,ZX2,ZX3 and ZX4 represent the standardized data of Investment value indicators of each country.

(2)Determination of principal component weight

According to the above analysis, the variance contribution rate of the first principal component is 70.480%, and the variance contribution rate of the second principal component is 20.723%. Therefore, the weight of the first principal component B1=0.7048, and the weight of the second principal component B2=0.20723.

(3)Principal component comprehensive score calculation

The formula for calculating the comprehensive score of principal component is as follows : $F = B_1F_1 + B_2F_2 + B_3F_3$

In this paper, SPSS25.0 is used to directly calculate the comprehensive score of Investment value of ports of various countries in 2018, as shown in Table 27:

Table 27:The Investment value of ports along the 21st Century Maritime Silk Road was scored in 2018

Countries	F1	F2	F
Malaysia	0.936	-0.443	0.568
Thailand	-0.042	0.127	-0.003
Cambodia	-0.383	-0.989	-0.475
Singapore	1.617	-0.650	1.005
Myanmar	-0.494	-0.776	-0.509
Turkey	-0.020	0.722	0.135
Iran	-0.301	0.080	-0.195
Qatar	0.069	-0.843	-0.126
Saudi Arabia	0.023	0.719	0.165
United Arab emirates	0.737	-0.441	0.428
Bangladesh	-0.556	-0.267	-0.447
Pakistan	-0.149	-0.376	-0.183
Sri Lanka	0.152	-0.850	-0.069
Ukraine	-0.496	-0.544	-0.462
Spain	0.318	2.077	0.655
Italy	-0.234	3.747	0.612
Greek	0.088	-0.570	-0.056
Netherlands	0.785	0.616	0.681
Nigeria	-0.760	0.178	-0.499
Algeria	-0.686	-0.394	-0.565

Libya	-0.692	-0.663	-0.625
Egypt	0.089	-0.462	-0.033

Chapter 4：Evaluation and comparative analysis of port Investment value

By the formula given by the third chapter and the data using SPSS25.0 can in turn calculated from 2015 to 2018, the 21st century the Investment value of countries along the maritime silk route of high and low, below shall be carried out in accordance with the regional sort.

4.1 Evaluation result of regional port Investment value

Table 28:Investment value of regional ports(Southeast Asia)

	Malaysia	Thailand	Cambodia	Singapore	Myanmar
2015	0.538	-0.021	-0.672	0.923	-0.673
2016	0.539	-0.018	-0.598	0.966	-0.624
2017	0.547	-0.019	-0.488	0.994	-0.591
2018	0.568	-0.003	-0.475	1.005	-0.509

Data source :SPSS25.0 calculation

Table 28 shows the Investment value estimation of the Investment value of ports of countries in Southeast Asia. From 2015 to 2018, the Investment value of ports of Singapore and Malaysia has always been the top two in Southeast Asia, mainly because of the good level of national economic development and the perfect infrastructure of ports. What is more important is that Singapore and Malaysia are located in the absolute geographical advantage of the shipping industry - the Strait of Malacca, the Strait of Malacca enables the region to develop transit trade. Cambodia and Myanmar are currently at the inferior level in Southeast Asia in terms of the Investment value of their ports, but on the other hand, it also indicates that there is a large room for improvement in this region.

Table 29:Investment value of regional ports(Middle East)

	Turkey	Iran	Qatar	Saudi Arabia	United Arab emirates
2015	0.127	-0.212	-0.129	0.154	0.419
2016	0.129	-0.213	-0.130	0.156	0.422
2017	0.134	-0.211	-0.128	0.159	0.426
2018	0.135	-0.195	-0.126	0.165	0.428

Data source :SPSS25.0 calculation

Table 29 shows the Investment value scores of ports in the Middle East region of the 21st Century Maritime Silk Road. From 2015 to 2018, Saudi Arabia and the United Arab Emirates scored higher, mainly because they are both Persian Gulf coastal countries and the world's most major oil producers with developed oil trade. Qatar and Iran scored low on the Investment value of their ports in the region, mainly because of political instability and the long history of international sanctions.

Table 30:Investment value of regional ports(South Asia)

	Bangladesh	Pakistan	Sri Lanka
2015	-0.619	-0.212	-0.097
2016	-0.612	-0.208	-0.093
2017	-0.566	-0.198	-0.087
2018	-0.447	-0.183	-0.069

Data source :SPSS25.0 calculation

Table 30 shows the Investment value scores of ports in South Asian countries along the 21st Century Maritime Silk Road. Overall, the region's score in the world, the medium level, but the score is growing very quickly in recent years, the reason is that South Asia is the 21st century along the maritime silk route layout of key areas, such as the construction of China and Pakistan's gwadar cooperation, China and Sri Lanka Colombo port cooperation, China's cooperation with chittagong, Bangladesh, etc. The

cooperation between China and the above countries has greatly improved the infrastructure level and container throughput of the ports in the region, so the Investment value of the ports is also rising rapidly.

Table 31:Investment value of regional ports(Europe)

	Ukraine	**Spain**	**Italy**	**Greek**	**Netherlands**
2015	-0.468	0.643	0.596	-0.078	0.669
2016	-0.468	0.644	0.598	-0.069	0.671
2017	-0.465	0.651	0.605	-0.066	0.673
2018	-0.462	0.655	0.612	-0.056	0.681

Data source :SPSS25.0 calculation

Table 31 shows the Investment value scores of ports in European countries along the 21st Century Maritime Silk Road. On the whole, the Investment value of local ports in Europe has a high score, because the countries in Europe have developed economy, perfect market economy system, perfect port infrastructure and high level of operation automation. The most important form of China's investment in Europe is equity control, among which the most famous is the participation of COSCO in the Piraeus Port in Greece, which makes the Investment value of Greece's ports rise rapidly in recent years due to the economic crisis.

Table 32:Investment value of regional ports(Africa)

	Nigeria	**Algeria**	**Libya**	**Egypt**
2015	-0.355	-0.602	-0.612	-0.039
2016	-0.272	-0.568	-0.597	-0.035
2017	-0.485	-0.544	-0.601	-0.061
2018	-0.499	-0.565	-0.625	-0.033

Table 32 shows the score of the Investment value of African ports. On the whole, it is not difficult to see that the Investment value of ports in Africa is low. Egypt, the highest country, scored only -0.033 points in 2018. The reasons are the sluggish level of economic development in Africa, backward infrastructure, domestic political chaos in some countries and the long-term impact of wars.

4.1.1 Comparative analysis of Investment value of each region

By comparing the Investment value of ports in Southeast Asia, the Middle East, South Asia, Europe and Africa, it can be seen that the region with the highest score of port Investment value is Europe and Southeast Asia, among which the most prominent country is Singapore. The region with the lowest port Investment value is Africa, where port infrastructure development is backward and the economy is underdeveloped. Therefore, investment in port construction in this region will face huge challenges and it is difficult to gain profits in a short period of time.

4.1.2 Investment value Orientation of Southeast Asia Ports

In the study of the Investment value of the ports of Southeast Asian countries, the most noteworthy ones are Singapore and Malaysia, which guard the Malacca Strait. Singapore and Malaysia are far higher than other countries in the Investment value score above, which is closely related to their geographical location. The Strait of Malacca is one of the busiest shipping lanes in the world. It is the gateway for maritime traffic between the Pacific and Indian Oceans. Today, the Strait of Malacca accounts for a quarter of world trade and a quarter of oil carriers pass through the strait. The Strait of Malacca is known in the world as the "crossroads of the sea" and "lifeline of the sea". The investment and construction of ports around the Strait of Malacca is in line with China's goal of investment and development of ports along the 21st Century Maritime Silk Road.[33]Currently, there are two major Chinese investment projects in Malaysia and Singapore: the Royal Port in Malaysia and the Port Berth Agreement in Singapore. The investment and construction of a port near the Strait of Malacca has the following two meanings:1. It is conducive to promoting the construction of a major international logistics channel and meeting the needs of international shipping development. A day after the ships of the malacca strait and China about 80%, 80% of China's oil imports from the Middle East through the channel, so China support huang jing port deep-water wharf construction is the Chinese government control over their own economy, China has 99 years after the completion of the project of the franchise and huang jing Hong Kong land ownership

of artificial islands, It will help China win the initiative in the Strait of Malacca and stabilize the overall situation of China's economic and trade development. 2. It conforms to the development vision of the 21st Century Maritime Silk Road and consolidates China's strategic position in Southeast Asia. The strait of malacca in the past for a long time without any project cooperation and China, as China's energy throat, once the country along the unpredictable risks will bring great obstacles to China's energy transport, so in Singapore and Malaysia have reliable anchorage port can help China in the region have their own voice. The choice of investment and port construction in Malacca is also in line with the vision of economic complementarity, practical cooperation and win-win development proposed by the 21st Century Maritime Silk Road.

In addition to the most important area of the Malacca Strait, Kyaukpyu port in Myanmar is also of Investment value. Although geographically myanmar does not have big advantage in particular, but investment in Burma after building part of the oil carrier can be directly shipped in the port to unload the Middle East oil, and through the oil pipeline to China, no need to get through the malacca strait and south China sea, can largely avoid energy dilemma brought by the political impact other countries.

4.1.3 Investment value Orientation of Middle East Ports

Saudi Arabia and the United Arab Emirates scored highest on the Investment value of ports among Middle Eastern countries. That's because the two countries are among the world's largest oil exporters, with the region exporting 80 percent of the world's oil. China's oil supply depends on exports from Middle Eastern countries. As a result, Saudi Arabia and the UAE also have the most developed port infrastructure and economy in the region. China should be in line with international standards in port construction. Participating in the construction of global smart port system is the future development direction of China's port industry. The connotation of smart port includes: intelligent, green and integrated transportation system; Efficient and competitive system equipment; Energy conservation and efficient use of energy; Positive influence on regional economic development; Safety and environmental friendliness. The premise of smart port construction is sound port infrastructure. For example, the

operation and investment of COSCO Shipping in UAE Khalifa Port in 2016 and the operation and investment of Power Construction of China in King Salman International Integrated Port Facility project in 2018 are all good attempts for smart port. Therefore, to strengthen the investment in port construction in this region is the actual embodiment of the Investment value evaluation of ports.[34]

4.1.4 Investment value orientation of South Asia ports

In South Asia, Bangladesh, Pakistan and Sri Lanka's Investment value scores very close, China is now in the three countries have port, the cooperation of investment projects, such as China and rebuilding work to chittagong, Bangladesh, China and Sri Lanka Colombo port cooperation, cooperation between China and Pakistan's gwadar port construction. The Investment value of the ports of these three countries has been rising rapidly in recent years under the cooperation with China, which has a great development prospect and long-term Investment value. Taking Gwadar Port for example, it has an excellent geographical location. Currently, it is the third largest deep-water port in Pakistan, which guards the Strait of Hormuz in the Persian Gulf and faces the Arabian Sea in the Indian Ocean to the south. It is an important coastal transit point for entering and leaving the Persian Gulf in the north, reaching Africa in the south and the Red Sea in the west. It is an important transportation hub along the "21st Century Maritime Silk Road" with countries in West Asia, the Middle East, South Asia, Africa and Europe, and a strategic economic development area to be developed. Gwadar Port has a good prospect for economic development. Located in the exclusive economic zone of Pakistan, Gwadar Port is rich in fish and seafood, and the nearby port area is very rich in mineral resources and gasoline resources. It has become one of the regions with relatively rich human resources, capital and technology in Pakistan. The political status of Gwadar Port is unique.[35]As a country that believes in Islam, Gwadar Port is the most important port connecting the Arabian Peninsula with the same belief. Supported by the common belief, it will be built into a regional economic and trade center with the exchange of oil and other resources as the medium and the goal of win-win cooperation. It is expected to deepen economic cooperation among countries in the region, including China, and effectively advance

regional economic integration. Sri Lanka's Colombo Port is also an important international port for the import and export of goods between Sri Lanka and India, and its influence radiates to the whole South Asia region. Therefore, the ports of South Asian countries are of long-term Investment value.

4.1.5 Investment value orientation of Europe ports

Among the European countries, the countries with higher port Investment value are Spain, Italy and the Netherlands, but it is worth noting that the Investment value of Greece's port has also risen very rapidly in recent years. The Investment value of ports in Europe is divided into two orientations: economic benefit and geographical benefit. Like China's COSCO shipping to acquire EUROMAX Rotterdam port, Spain Naotum port, Italy equivalent behavior such as the largest container terminal is the purpose of economic benefit, because of the developed countries of Europe port infrastructure, early don't need to spend a lot of money for infrastructure construction, and the trade of developed countries, Investment in ports in the region can maximize economic benefits. For example, China's investment in the Piraeus port in Greece is more for the construction of the "China-Europe Land and Sea Express Line". Piraeus Port is a transit port for ships to go to the Atlantic Ocean through the Mediterranean Sea, the Indian Ocean through the Red Sea, and the Black Sea through the Sea of Marmara, connecting the Balkan Peninsula, southern Europe, the Black Sea and Western Europe, Central and Eastern Europe, the Middle East, and Africa.[36] Its geographical location is very important. The China-Europe Sea and Land Express Line, when completed, will open up a new and convenient route for China's import and export trade with Europe, which will shorten at least 7-11 days compared with the traditional route.

4.1.6 Investment value orientation of Africa ports

Among African countries, only Egypt has a high port Investment value. The port Investment value of other countries is at the lowest level in the world and fluctuates greatly, which is caused by national politics and economy. Therefore, in the region of African countries, the port investment direction should be focused on Egypt - the country guarding the Suez Canal. Egypt is the geographical intersection "area" initiative, promoting the construction of "area" is difficult to circumvent the important

country, Egypt's main port city of Alexandria, port said, du mia, suez port, etc., but now only Hong Kong group as the main contractors and operators participate in suha port and du mia port expansion project of the two ports. In general, China's direct investment and construction of port projects in Egypt is relatively limited, and the projects it participates in are basically port service functional projects and port peripheral supporting facilities projects. From the perspective of investment scale and Investment value chain level of the acquired projects, China is still in the initial stage of participation. Nevertheless, it is of great significance for China to invest in Egypt's port construction. As a key country in China's "21st Century Maritime Silk Road" strategy, China's participation in the all-round construction of Egypt's port and its surrounding infrastructure essentially promotes the realization of the "Maritime Silk Road" construction goal. China's participation in and investment in Egypt's port construction has improved the infrastructure of Egypt's ports and industrial parks, effectively promoted the division of labor and cooperation in the industrial chain, and thus accelerated China-Egypt cooperation on international production capacity.

4.2 Investment Suggestions based on the current state of the port

4.2.1 Proposals for cooperation and government

Most of China's port cooperation projects on the "21st Century Maritime Silk Road" are focused on the ports on important shipping routes in the South China Sea region, such as Singapore Port, King Port, Kuala Lumpur Port, Kyaukpyu Port, etc. Southeast Asian countries have common interests in port cooperation, which is the basis of establishing regional port cooperation mechanism. The author believes that port cooperation should continue to develop in the following three directions: the construction of port infrastructure and shipping routes, the improvement of port facilitation and the promotion of port security.

At present, the trade between China and Southeast Asian countries is dominated by port transportation, so the port infrastructure construction has a huge realistic demand. The measures that can be taken to improve port infrastructure construction include dredging sea lanes, increasing port berths, expanding port throughput, and allocating

handling facilities and equipment. In the construction of routes, we can expand the number of regional routes between countries and speed up liner flights.

Since the establishment of port cooperation between China and other countries, the development direction has been to improve the degree of port facilitation and port service efficiency, promote the efficiency of port logistics and unify and coordinate customs clearance standards. For example, port electronic data sharing, "single window certification", AEO certification and other initiatives.

Port security construction is also an important part of port cooperation. The cooperative ports should make joint efforts under the framework of the International Maritime Organization (IMO) to strengthen work in the areas of port state supervision, port safety and maritime security and Marine environmental protection. In cooperation to carry out the United Nations convention on the law, international convention on safety of life at sea, the international convention on the prevention of pollution, the international safety management rules.

The implementation of the 21st-Century Maritime Silk Road initiative is a comprehensive strategy involving politics, economy, culture, and diplomacy. The Chinese government can take the following measures to promote overseas port cooperation: 1. We will promote port construction and connectivity. We will develop the Marine industry and strengthen the foundation for cooperation. We will reform the financial mechanism and investment framework and encourage financial cooperation. We will formulate new economic rules and build a platform for trade cooperation. To invest in more ports overseas, China needs to establish an open economic system and develop in harmony with the rest of the world.

4.2.2 Proposals for construction and investment

China's port construction projects on the "21st Century Maritime Silk Road" are distributed in various continents, such as Kuantan Port in Malaysia, Colombo Port and Hambantota Port in Sri Lanka, Kyaukpyu Port in Myanmar, Gwadar Port in Pakistan, King Port in Malaysia, and Euromax Terminal in Rotterdam. In recent years, as the increment of domestic port infrastructure slows down, domestic port construction enterprises are forced to go overseas. It has become a general trend to invest in

overseas However, overseas investment is faced with great potential risks:

1. Political risk: Political risk refers to the political instability of some countries in port construction, which will delay the port construction project and bring huge hidden danger once the change occurs.

2.Security risk:Security risk refers to the impact of war and terrorist attacks on the port construction of the country where the port is located

3.Economic risk:Economic risk means that different countries have different Economic systems, some countries have trade protection, port investment may not bring profits, resulting in financial losses.

4.Legal risk：Legal risk refers to the fact that the laws of the country in which the port is invested may hinder the process of port investment.

Therefore, China's overseas port investment should investigate these five potential risks in advance, reasonably avoid or transfer risks, and reduce the potential risks to a minimum.

Chapter 5：Summary and Outlook

5.1 Summary

This paper uses the principal component analysis method to evaluate the Investment value of the ports of the countries along the Maritime Silk Road in the 21st century from 2015 to 2018. Based on the evaluation, combined with qualitative analysis (political factors, geographical factors, economic factors) Evaluate the development direction of the national port strategy in each region. Concluded as follow:

1. The Investment value of the port largely depends on the geographical location of the port. For example, the ports close to the Strait of Malacca, the Strait of Hormuz, and the Suez Canal have great political and economic Investment value. The corresponding ports are Huangjing Port, Gwadar Port, and Port Said.

2. The port's infrastructure construction and regional economy also largely affect the Investment value of the port. For example, in Europe, investing in port construction in this region can greatly shorten the investment return period and has an advantage in economic Investment value. Corresponding ports are Rotterdam EUROMAX Terminal, Italy Dowa Port, Greece Piraeus Port.

3. The Investment value of China's investment and establishment of a port can increase significantly in a short period of time. Therefore, when considering the Investment value of the port, the current Investment value score should not be considered alone. Long-term strategic vision should be taken into consideration. Long-term Investment value.

4. When investing in a port, it will face many risks, such as political risk, security risk, economic risk, and legal risk. Investors should fully understand the political, economic, and legal policies of the port country before investing. Factors of port investment and construction.

5.2 Outlook

The port is a key carrier for the implementation of the 21st Century Maritime Silk

Road Initiative, and an important node for strengthening the interconnection of the infrastructure of the countries along the Maritime Silk Road. This article puts forward two constructive suggestions to enhance the Investment value of the port through the above exploration:

1. Strengthen the construction of port infrastructure and improve the level of port operations. The level of port hardware infrastructure is an important indicator to measure the Investment value of ports. Investment operators should increase financial investment, carry out targeted port infrastructure upgrade plans, and improve the number of port channels, channel depths, and number of berths. Use advanced operating concepts to improve port operations.

2. Develop the construction of a global smart port system. Use the new generation of intelligent network data such as big data and artificial intelligence to build a smart port and build a smart, green, and integrated transportation system.

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Appendices

Appendix 1:Standardized data of 2018 port Investment value evaluation indicators

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Malaysia	0.79583	1.75439	1.59062	-0.23005
Thailand	-0.22859	0.26349	-0.16453	0.07892
Cambodia	-0.13546	-0.86794	-1.26055	-0.89968
Singapore	1.91339	3.01467	2.27272	-0.19176
Myanmar	-0.60111	-0.80839	-1.26055	-0.79493
Turkey	-0.04233	0.12815	0.16830	0.63096
Iran	-0.49867	-0.53771	-0.31989	-0.02773
Qatar	0.98209	-0.74884	-0.34201	-0.57731
Saudi Arabia	0.09736	-0.00935	0.36476	0.64749
United Arab emirates	1.54087	1.11451	0.54195	-0.09226
Bangladesh	-0.88050	-0.64166	-1.18174	-0.39314
Pakistan	0.15324	-0.59293	-0.44095	-0.31085
Sri Lanka	-0.04233	-0.19016	0.53033	-0.77003
Ukraine	-1.06676	-0.82030	-0.66917	-0.68378
Spain	0.53507	0.91312	1.03071	1.93785

Italy	-0.08890	0.42698	0.38177	3.29831
Greek	0.06011	-0.37206	0.44386	-0.50665
Netherlands	2.00652	0.65760	1.25439	0.90642
Nigeria	-1.62553	-0.81705	-0.98640	-0.14306
Algeria	-1.34615	-0.78890	-1.23021	-0.59342
Libya	-1.39271	-0.93832	-1.19194	-0.84277
Egypt	-0.13546	-0.13928	0.46852	-0.44253