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SHANGHAI MARITIME UNIVERSITY
WORLD MARITIME UNIVERSITY



Shanghai, China

**Research on port network layout from
the perspective of sea ports and dry ports
linked development under the background of
“OBOR”**

By

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China

A research paper submitted to the World Maritime University in partial
fulfillment of the requirements for the award of the degree of

MASTER OF SCIENCE

In

INTERNATIOANL TRANSPORT AND LOGISTICS

2015

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.

.....

.....

Supervised by

Professor Wang Xuefeng
Shanghai Maritime Universi

ACKNOWLEDGEMENTS

Thesis writing is coming to finish. In the process of writing in this period, I got a lot of help from supervisor and friends. I would like to express my gratitude to all those who helped me during the writing of this thesis.

I would like to particularly thank to my supervisor professor Wang Xuefeng. Under the direction of my professor, I found a breakthrough successfully. In the process of choosing suitable analysis models, professor also devoted a lot of efforts and gave me valuable advice. Then my designing became more practical and had more realistic significance.

Once again thanks to the group of professors participate in the paper review and reply and all those who helped me during the writing of this thesis!

ABSTRACT

The relevant issues about dry port have been drawn greater attention since China put forward “OBOR” strategy. Now, the construction issues of dry ports are of more strategic significant. For inland cities, setting dry port can facilitate the construction of inland logistics channels, increasing the speed of goods circulation, promoting the development of export oriented economy. For sea port, setting dry port can expand economic hinterland, release sea port conjunction problem effectively.

Going through all the relevant studies of dry port, it can be noticed that relatively more conditions are spare to the issue about the linkage development relationship between sea port and dry port. Under the background of “OBOR” the linked relationship between dry ports and sea ports exist some problems. To a large extent, these problems are caused by unscientific port network layout. To solve this problem, a gravity model between dry port and sea port is been established. Then 24 “OBOR” alongside international dry ports and 10 sea ports are selected based on all kinds of sound reasons. According to the gravity model, the dissertation accounts the amount of gravity between each dry port and each sea ports. Finally, network analysis method is used to analyze the result of gravity model. This step helps with finding out both core inland cities which are suitable to build comprehensive international dry port and core logistics networks which desire more attention. Furthermore, the dissertation studies different kinds of linkage development modes, then analyzes the linkage development relationship between sea port and dry port based on the result of gravity analysis, and targeted suggestions are came up at the end of the dissertation.

Main researches of the dissertation are list as follow:

Firstly, the dissertation introduces the definition, feature, function and significance of dry ports. The purpose of this part is to get a better understanding and awareness of dry ports.

Then, the dissertation studies the formation mechanism of dry port and the problems of the linked relationship between dry ports and sea ports under the

background of “OBOR”. Based on the construction of realistic dry ports, this part not only reveals the driven power behind dry port construction originally, but also comes up different formation processes of dry port. The study result can be a reference to dry port construction and selection issues. Then to lay the groundwork for chapter four, the problems about the linked relationship between dry ports and sea ports are been studied.

Furthermore, to solve the problem of unscientific dry port network layout, a gravity model between dry port and sea port is been established. Then 24 “OROB” alongside international dry ports and 10 sea ports are selected based on all kinds of sound reasons. According to the gravity model, this part accounts the amount of gravity between each dry port and each sea ports. Finally, network analysis method is used to analyze the result of former result of gravity model. This part helps with finding out both core inland cities which are suitable to build comprehensive international dry port and core logistics networks which desire more attention.

After that, the dissertation studies different kinds of linkage development modes, then analyze the linkage development relationship between sea port and dry port based on the result of gravity analysis, and targeted suggestions are came up at the end of the dissertation.

Finally, the conclusions and the deficiencies of the dissertation are been summarized.

KEYWORDS: OBOR, dry port, linkage development relationship, network layout, gravity model, centrality analysis

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Chapter 1 Introduction

1.1 The research background and significance

1.1.1 Background

Since the reform and opening up, China's international trade keeps developing. The speed grew even faster after China's accession to the WTO. China established tight trading partnerships world wide. Despite the impact of the financial crisis in 2009, China's total imports and exports still reached \$220730 billion, the total number is the biggest among the world.

In China, the cities which perform well in international trading are to a large extent located in coastal areas. However, hindered by poor transportation infrastructure, the majority of the inland areas play not so good in this field. To deal with this problem inland areas are in dire need of building international logistics corridor. Meanwhile, coastal port cities fall into fierce competition to struggle more cargo supply resources, which contributes to the tight partnerships between port cities and inland cities. Building dry ports in inland areas can meet the mutual benefit of port cities and inland cities, and based on this reason, large number of inland cities set up dry ports under the support of local governments or port cities.

Along with the building of dry ports, the conception of dry port has been renewed constantly. According to realities and specific requirements, besides offering the basic inherent functions, dry ports have been came up with various additional services with high service level, making great sense to the inland cities, port cities, carriers and shippers.

The relevant issues about dry port have been drawn greater attention since China put forward "OBOR" strategy. Now, the construction issues of dry ports are of more strategic significant. General secretary Xi Jinping proposed "OBOR" blueprint, which not only smoothes the construction of new Eurasian Continental Bridge, but also

tightens the trading relation between Asia and Europe. The Silk Economic Zone covers Asia and Europe, and exerts influence among 30 countries, stimulating international business profoundly. As for Inland cities, the sense of proposing “OBOR” is more profound than other places. The building of Silk Economic Zone not only helps the west China to make good use of both foreign market and domestic market, but also helps the area to get benefits from the resources worldwide. Then every corner of China connected with each other, not matter in what direction, the whole country looks like an economic corridor. Through this way China can fulfill her dream of further opening up and innovative promotion.

Since it is a good chance for inland cities to enlarge their financial power and influence, no one willing to miss it. To meet the target of enlarging trading volume, many cities plan to construct international dry ports. They even think it is the sole way to achieve a tremendous promotion. They embark on formulating policies and regulations, building logistics parks and planning logistics transportation network, being afraid to be left behind. However, they put too much attention to speed, neglecting many important aspects, all of these come out with some bad results. For example, since inland cities pay attention to their own benefit, they separate from each other, resulting linked development can't develop profoundly. They embark on the dry port construction without clear recognition and analysis of their local realities. Being unclear about local strength makes dry ports built in different cities have the same function, it is hard for these dry ports to be stuck out, and it is easy to substitute one dry port by another nearby. All these functions of dry ports can't be utilized utmostly. Furthermore, limited resources would be abused if the dry ports be constructed in wrong way, and the development of “OBOR” plan would also be influenced. Based on this background, the dissertation comes up the research on port network layout from the perspective of harbors and dry ports linked development based on the background of “OBOR”.

1.1.2 Research significance

In China, the study of dry port relevant problems came up in twentieth century. However, the research from the aspect of sea ports and dry ports linked development is deficient. What is dry port? Dry port owns all the functions of sea port except vessel charging and discharging, it is the result of supply chain integration, which involves sea port, transport channel and inland cities. Nowadays, the competition between cities is more complicated than before, the competition is more about the supply chain of a series of cities. From this point, the study of the linked development relationship between harbors and dry ports is valuable.

China is now in the critical period of reform and transformation, which full of chances and challenges. Inland cities need to reorient themselves precisely when they take the chances and build dry ports. Only in this way can they distinguish themselves from others, make good use of available resources, located in a more important position when they cooperate with sea ports. The development of “OBOR” alongside dry ports are studied both from qualitative and quantitative aspects in this dissertation. Different kinds of scale and development target should be fit with different dry ports. Furthermore, this dissertation can be a reference for local authority to formulate dry port construction related policies.

This dissertation also studies about the linked development relationship between sea ports and dry ports, which lays the foundation of feasible suggestions of building efficient linkage development relationship between sea ports and dry ports. How is the linkage relationship going can exert a big influence to the situation of supply chain. To be clearer, a good linkage development relationship can help sea ports with expanding hinterland, increasing cargo supplying, releasing congestion, and thus promote its function and competitiveness. From dry ports aspect, the relationship can arm them with convenient efficient international logistics channels, which makes it possible for them to join international markets, lower logistics costs, improve the efficiency of circulation and promote industrial upgrading.

1.2 Literature review

1.2.1 Recent research of dry port

Both professors in China and abroad have done quite a lot of research on dry ports.

Firstly, people focused most on the definition of dry port at the beginning. Violeta Roso (2007) thought the dry port concept is based on a seaport directly connected by rail with inland intermodal terminals where shippers can leave and/or collect their goods in intermodal loading units as if directly at the seaport ^[1]. In China, the study began at an early age. Xi Ping (2001) thought dry port is the hub connected with sea port directly, it is set under relevant convention and law, and the purpose is to adapt the requirement from international trade progress ^[2]. Then Wang Hongwei (2004) defined dry port from its function ^[3]. He thought it is one connected point in the container transportation layout, which exists between different transportation ways. It offers many services such as distribution, Loading and unloading, storing, and Customs inspection.

Then, People turned to study the advantages brought by dry port. Jolanda Prozzi (2002) focused on the three main benefits coursed by dry port, and they are social benefits, private benefit and public benefit ^[4]. Violeta Roso (2007) set Boras as example, then he found out that the CO₂ emission reduced 25% as Boras became a dry port, and the congestion rate was reduced as well ^[5]. After that, Violeta Roso (2008) notice that the main obstacles for building a new dry port are infrastructure, land use, environmental, and legislative ^[6]. In China, Guan Yi (2007) thought the selection of an appropriate dry port as a cooperater is critical for sea ports, since it can enlarge their cargo volume ^[7]. Zhang Hongbo (2008) studied about the necessity to construct the Changchun international dry port, and he suggested that Changchun should become a dry port at the beginning, becoming a special economic zone after that ^[8]. Fen Xueli (2008) believed that the construction of dry port not only brings a

lot advantage to the economic development of local and surrounding areas, but also provide a stable supply to the coastal ports ^[9]. Since dry port is a significant place where conducts foreign trade, so the hub's development speed, scale, and the quality of the services provided will affect a country or region's foreign trade development.

Some people interested in studying the function and development mode of dry port. C.K.walter (2003) once investigated the carrier and shipper in Iowa, noticing some differences existed in their requirements toward dry port ^[10]. Poist R.F. (2004) introduced the current situation the North American dry port, and he list different requirements owned by different shippers ^[11]. Fedele Iannone (2007) elaborated the dry ports' function which located in Italy ^[12]. Besides this, he told about the feature of rail way system by which dry port and sea port connected with each other. Ballis A (2002) studied about the terminal of rail system ^[13]. Meanwhile, he comparer one terminal with others. In china, Jiang Hua (2008) discussed the main function of Xian international dry port, and she also analyzed the dry port's regional plan ^[14]. Liang Zuojun (2002) did a reach toward Dalian logistics market, and based on this he positioned the dry port precisely ^[15]. According to the position, he defined the main functions possessed by Dalian dry port. Zhang Zhaoming's (2010) study was mainly about the impetus behind the formation of dry port ^[16]. He confirmed that the formation and development of dry port is the result of three kinds of outside power, and they are demand, adaptability, and promoting power. Zhang Lili (2009) studied about the advantages caused by the interrelation between international shipping centre and dry port ^[17].

Finally, the most attracting topic is related to the selection of locations for dry port. Rutten, and B.C.M (1998) discussed about inland intermodal station, integrated transportation network layout, and dry port location issues in their pepper, besides this, they elaborated the factors that needed to be took into consideration when we think about the location of dry ports ^[18]. Mansour R. (2008) constructed a model to deal whit dry port location problem ^[19]. The result of this model shows that the

construction of dry ports within whole transportation system not only can shorten the original distance, but also can eliminate pollution problem. Yuanquan Xu (1999) created a model to deal with container dry port location problem ^[20]. Gendron(2003) used different way to deal with container dry port location problem ^[21]. Samir Awad-Núñez (2004) provided a decision-making methodology based on the use of DELPHI methodology and Geographic Information Systems, and his purpose was to find out the main factors that influence dry port location decision making process ^[22]. Daniela Ambrosino, and Anna Sciomachen (2014) wrote a paper to deal with the problem of locating dry ports for freight mobility in intermodal networks ^[23]. In particular, the containerized flows originating at the maritime terminals of the port of Genoa, Italy, towards inland destinations throughout rail and road itineraries are examined. In China, Xu Jie(2001), Tang Xifeng (2009), Zhang Dezhi (2005), and Lin Chunyu (2005) discussed about the location affecting factors and algorithms respectively ^[24~27]. Zhou Hongwei (2009) used a fuzzy clustering arithmetic based on Genetic Algorithm to analyze the dry port location problem within northeast China. Tang Ka (2009) analyzed the location of dry ports which Guanzhou seaport should coordinate with by AHP, and the purpose is to build a systematic transportation layout in Guanzhou region ^[28~29]. Fang Qing (2008) thought that the factors needed to be taken into account when we think about dry port location problem can be separated into two kinds, one is economic factors and the other is non economic factors ^[30]. Then she constructed a model to deal with location problem by using flow method. Finally, she got a plan about how to program dry port location within Guizhou region. Zhang Zhaomin (2008) used fuzzy c-means algorithm to select the most suitable dry port location, and he used actual data from 34 cities which are known for their cargo source to testify his result ^[31]. Chen Cisheng (2005) studied about the traditional way to decide the location of dry port, then according to the feature of empty container dry port he built a mixed-integer programming model ^[32].

1.2.2 Recent research of the linkage development between seaport and dry port

The topic has been studied by both Chinese and foreign professors for many years, and they have come up with many remarkable results.

Since a dry port can be regarded as a point, which offers logistics services and is connected with a seaport, so the linkage relationship between two ports can be regarded as the relationship between a seaport and hinterland. Foreign countries have done a lot of researches. The German scholar Gorz published “seaport location theory” in 1934, he thought the location of a seaport is mainly decided by the development of its hinterland [33]. This opinion was supported by Patton (1958) and Morgan (1958) also [34~35]. Mayer (1957), Welgend (1958) studied about the joint cost of water way, port, and hinterland from the whole point of view [36~37]. Kenyon (1970), Mayer (1978) both thought the competition between different ports can be present by many aspects, which covered labor costs, rail way accessibility, and land availability [38~39]. Hayuth (1987), Slack (1990, 1975) have done many researches in this field, they not only believed that the scope of hinterland would be enlarged, but also believed that the relationship between seaport and hinterland would become more and more complicated [40~42]. Anu Bask (2014) made a big contribution to the understanding of the development of seaport–dry port dyads by the analysis of two in-depth case studies from Northern Europe [43]. The results contribute to earlier studies of spatial development of seaport–dry port development by taking into account development over time and by increasing the understanding of the actors, the types of dry ports and the services influencing the development of the dyads. In China, Gao Feifei (2011) established an evaluation index system from the angle of the macro and micro for the relationship between seaport and dry port, besides this, she also evaluated the level of cooperation between two ports by using the principal component analysis method [44]. Jiang Weixiang (2011) applied system dynamics theory to analyze the cooperation level between two ports [45]. Zheng Haili (2011) thought relation between two ports shows seven different levels, according to this he built an evaluation index system,

and built a Back Propagation model [46].

1.3 Research methods

This dissertation studies the linked development relationship of dry ports and sea ports by using gravity model. At the beginning, a gravity model of dry ports and sea ports is been built. Then 24 “OBOR” alongside dry ports and 10 sea ports are selected based on all kinds of sound reasons. According to the gravity model, the dissertation accounts the amount of gravity between each dry port and each sea ports. Finally, network analysis method is used to analyze the result of the gravity model. It helps with finding out both core inland cities which are suitable to build comprehensive international dry port and core logistics networks which desire more attention.

Chapter 2 Related theory research of dry port under the background of “OBOR”

2.1 The concept of international dry ports

Toward international dry port, there still do not have clear definition, no matter in abroad or at home.

The European Commission considered dry ports as inland logistics point that connected with sea port directly. Leveque and Roso believed dry port is the terminal which connected with sea ports by railway channels. Besides this, they also thought dry port plays the same function as sea port, which includes cargo collection and picking up, customs clearance and other services.

In 1992, American Container Association came up a definition for dry port. They thought, dry port is an inland container facility which is far from the sea port, it provides container loading and unloading service, short-term storage service, customs clearance services, and other services. The main purpose of dry port is to achieve inland containerization, taking the benefit of container transportation. The transportation period between dry port and sea port is under the supervision of customs, shipping companies usually issue their own bills of lading, and response for the transportation operation and cost from dry port to foreign ports or other foreign destinations. The definition given by American Container Association explains the main function of dry port. However, it did not distinguish the difference between the dry ports and other ordinary container freight stations.

Some Chinese scholars also came out the definitions of dry port. Xi Ping raised the definition of dry port based on the requirement of improving inland international trade condition. He thought dry port is the inland join point of railway and highway, besides, it is the business port set by inland authorities based on international transport

laws, treaties and practices. Furthermore, dry port can be regard as feed port and logistics operation platform of sea port which located in hinterland, providing hinterland with quick and convenient international port services.

Zhang Rong defined dry port as inland terminal which provides a series of services for containers. These services include cargo charging and discharging services, devanning services, temporary storage and customs clearance services. The main purpose of dry port is to offer container multimodal transport services for inland shippers and consignees, making the benefit of containerization be expanded in inland area.

Yang Rui thought dry port should be defined as container freight station, which works for local customers and shipping companies. Dry port owns all the functions of sea port, except ship charging and discharging. Shipping companies set branches and container yard in inland cities, all these places play an important role in cargo collection, container recession, and bill of lading offering. Inland import and export traders can apply for booking, customs declaration, inspection and other formalities locally, achieving “door to door” service eventually.

Obviously, different definitions focus on different points, which might be caused by the discrimination of national conditions and environment. It is must be confirmed that most of these definitions are limited. Nowadays, “OBOR” always been took into consideration when people mention relevant issues of dry port. There for, the precondition of “OBOR” has to be took into account when we define dry port. Basing on the definition offered by former scholars, this dissertation tries to come up a new definition of dry port, which reflects the dry port agreement between 14 Asia Pacific countries, and the agreement named “Intergovernmental Agreement on Dry Ports”. According to the “Intergovernmental Agreement on Dry Ports”, for the purpose of the agreement, a dry port of international importance shall refer to an inland location as a logistics centre connected to one or more modes of transport for the handling, storage and regulatory inspection of goods moving in international trade

and the execution of applicable customs control and formalities. The dry ports are normally located in the vicinity of: (a) inland capitals, provincial/state capitals; and/or (b) existing and/or potential production and consumption centers with access to highways and/or railways including the Asian Highway and/or Trans-Asian Railway, as appropriate. Dry ports have transport connections to other dry ports, border posts/land customs stations/integrated check posts, seaports, inland waterway terminals and/or airports.

2.2 The characteristics of international dry port

According to the new definition of dry port, the international dry ports' characteristics are listed as following:

2.2.1 Located in the inland areas

“Intergovernmental Agreement on Dry Ports” sticks out that international dry ports must located in inland capital cities or business centers. Most of 17 Chinese dry ports cities listed by “Intergovernmental Agreement on Dry Ports” are hinterland cities, besides this, they are also located in boundary area. Large numbers of them relay on tight business relationship with nearby countries, for example, Khorgos, Manchuria and Er Lian Hao Te.

2.2.2 Convenient customs clearance

One of the most important functions of international dry port is to offer customs, inspection, quarantine and other government department services. All government related procedures can be done in dry port, and sea ports can be released from these issues. Through this way, cargo circulation efficiency can be dramatically improved, operation cost can be reduced at the same time. Finally, the important role played by dry port in international trade can be more prominent.

2.2.3 The extended function of coastal ports in inland area

International dry port owns all the functions of sea port, except ship charging and discharging services. It is the extended function of coastal ports in inland area. In dry

port, the container stuffing, container dispatching, container temporary storage, custom clearance is available, and all these services are only be offered in sea ports before.

2.2.4 Connected with coastal cities with convenient transportation channels

Dry port generally connected with sea ports by highways or railways. Inland cargos are gathered at dry port at the beginning, then the cargos be transported to sea ports through highways or railways. From another side, import cargos are gathered at sea port, and then be sent to dry ports by the convenient high speed paths.

To achieve fluent transportation in “OBOR” area, Chinese government is planning to build six main railway channels based on the middle path and the south path of the silk road economic zone. The details are list as follow:

1. To the Euro-Atlantic coast: China - Alashankou (China) - Astana (Kazakhstan) - Moscow (Russia) - Minsk (Belarus) - Warsaw (Poland) - Berlin (Germany) - Amsterdam (Netherlands).
2. To Europe Baltic (Nordic): China - Alashankou (China) - Astana (Kazakhstan) - Moscow (Russia) - St Petersburg (Russia) - Helsinki (Finland).
3. Black Sea to Europe (CEE): China - Horgos (China) - Almaty (Kazakhstan) - Volgograd (Russia) - Lviv (Ukraine).
4. The Black Sea coast to Valencia (Valencia): China - metol pregnant special (China) - Jalalabad (Kyrgyzstan) - Tashkent (Uzbekistan) - Ashgabat (Turkmenistan) - Tehran (Iran) - Ankara (Turkey) - Istanbul (Turkey).
5. To Africa, the Mediterranean (North Africa): China - spit Erduo Te (China) - Jalalabad (Kyrgyzstan) - Tashkent (Uzbekistan) - Ashgabat (Turkmenistan) - Tehran (Iran) - Baghdad (Iraq) - Amman (Jordan) - Cairo (Egypt).
6. To the Arabian Sea coast of Asia (South Asia): China - Khunjerab (China) - Islamabad (Pakistan) - Karachi (Pakistan).

2.3 Functions of international dry port

2.3.1 The basic function of international dry port

The basic function of international dry port is the function owned by all international dry port.

1. Container storage and distribution function

Dry port plays an important role in the inland and international container transit, in this period the main function of dry port is to offer container keeping service, container storage service, container stuffing services, devanning services, tallying services and other services. Besides, shippers are allowed to pass their cargos to carriers in inland cities, not only limited within sea ports as before. All these services help to gather all kind of cargos in relatively small scale, making them possible to be transited to sea ports by fulfilled containers.

Dry port is the important point for cargo gathering and dispatching, meanwhile, it plays a significant role to bridge sea ports, air ports, and border trading-ports. Dry port not only can gather/dispatch cargos in high speed, but also can offer stable and reliable cargo resources, improving the level of containerization in inland area ^[47]. Furthermore, the container service offered by dry port improves the efficiency of transportation, speeding up the transfer of containers. Setting international dry port can track and manage containers in inland areas effectively, overcoming empty container transportation problem and shortening the transfer period when containers be transported from sea port to dry port. From another aspect, setting international dry port can promote the development of multimodal transportation, reducing the cost caused during transportation. The purpose of “door to door” transportation would be fulfilled if the functions of dry port are made good use of. In this situation, shippers are able to finish devanning and container stuffing procedure in dry port, then making it possible to do “door to door” service without traveling between sea ports and inland cities over and over again ^[48~49]. On the contrary, if the functions of dry port do not

be utilize fully, cargos in small scale would be transit to sea port respectively, then finish the step of fulfilling container in sea port side. It would deteriorate the traffic congestion problem of sea port, besides, obviously, the benefit of container transit do not be exerted.

2. Customs clearance, inspection and quarantine functions

The most obvious difference between dry port and inland container station or inland logistics center is that customs clearance, inspection and quarantine functions are available in dry port. According to article 8 of “The Customs Law of the people's Republic of China”, inbound and outbound transport vehicles and goods have to pass the station which set by customs office. SO, customs clearance is an essential part of international logistics. Customs supervision’s basic systems include declaration, inspection, taxation, final clearance, and all of these are based on Chinese policies and regulations. Customs supervision is one of national duties, its purpose is not only to ensure all export and import activities are in accordance with national policies, laws and regulations, but also to safeguard national sovereignty and interests.

3. Freight forwarding function

Freight forwarding means the group who aims at customer’s benefit and takes goods from customers according to the customer's instructions. Freight forwarding company is also responsible for cargo storage, customs declaration and inspection. As the development of freight forwarding, the service offered by the company is expanded, they not only work for shippers, carriers, but also work for customs and other authorities.

Dry port offers freight forwarding support can help shippers and carriers with cargo receiving, cargo dispatching, bill of lading offering, container management and customs clearance. It plays a role as bridge between shipper, carrier, sea port, air port and warehouse. Freight forwarding service not only promotes the development of international trade and transportation, but also promotes the development of national economy and globalization of the world economy.

4. Transference function

Since dry port is an important logistics center located in inland cities, playing a significant role in cargo gathering and dispatching, so the function of transference is required. To offer transference function dry ports have to arm themselves with all kinds of modes of transportation, and assure high efficiency when transfer one mode of transportation to another.

5. Comprehensive warehousing functions

Being an important logistics center, comprehensive warehousing is dry port's basic function. The traditional function of dry port is to offer storage service, adjusting time difference between production and consumption. However, as the rapid development of modern logistics, the former function of warehouse is unable to fulfill the requirement of customer, and some additional services are asked by customer. These additional services include product packaging and distribution processing.

6. Distribution function

Distribution function is indispensable when dry port support international and inland logistics operations. Distribution function is the symbol of the development of modern logistics, and it almost covers all the logistics factors, reflecting the epitome of modern logistics to a certain extent. Distribution function is not just confined in cargo transportation, it also thinks highly of packaging and distribution processing procedure.

2.3.2 The expanded function of dry port

The expanded functions of dry port which came up based on dry port basic functions are not indispensable. They are available in some dry port in relatively big scale. To meet the needs of economic development and exploit the advantages to the full, some dry port come up all kinds of additional functions, making the service become more comprehensive.

1. Bonded logistics function

To offer a better service for foreign trade, some dry ports propose to provide

Bonded logistics service. By doing this, those dry port became more attraction and competitive as time pass by. To achieve this function, local authorities usually take three methods, which includes bonded warehouse, export supervised warehouse and bonded logistics center. Distinguishing from these three methods is quite important. Firstly, bonded warehouse means the place established under the approval of the Customs, and the setting purpose is to storage bonded goods and other cargos that haven't finish the procedure of custom clearance ^[50]. Then export supervised warehouse means the place be set under the approval of the customs, and store the export cargos which just finish the procedure of custom clearance ^[51]. Finally, bonded logistics center means the place be set up under the supervision of customs, and be made up by a single or many logistics companies. The purpose of bonded logistics center is to offer bonded warehouse, transference, packaging and distribution processing procedure, maintenance and customs clearance services.

2. Information processing and supporting

To play information processing and supporting function, some dry ports propose to construct the logistics information platforms. Logistics information platforms are comprehensive systems which include data acquisition, analysis and processing, helping a lot in information communication. Logistics information platforms work for the requirement of logistics information, network declaration and on-line transactions.

3. Financial services

It is impossible for dry port to get long term development without the support of financial department. So, attracting financial department and making them set branches in dry port make great difference to the development of dry port. Logistics operation involves many activities and faces a lot risks, so companies need the support of all kinds of insurances to reduce the possibility of losing money. Besides offering insurance services, dry port can also try to come up some new financial services, such as bill of lading mortgage service.

2.4 The significance of dry port under the background of “OBOR”

2.4.1 International dry port helps to promote the development of inland cities

1. International dry port helps inland cities with opening up

International dry ports located in “OBOR” alongside are important platform for economic globalization. Undoubtedly, international dry ports are bridges between inland cities and coastal cities. And they are the windows of foreign trade, the engines of export oriented economy, the hubs of logistics system. Setting dry ports not only can attract production factors, but also can promote interaction between sea ports and inland ports. Besides, it also facilitates the procedure of logistics, information flow, capital flow, business flow.

Then, setting dry ports can help inland cities to develop an export-oriented economy. The reason is that dry ports can attract the investment from foreign companies. For example, since Baotou set dry port in 2008, more than 1000 foreign companies have been set branched in there, and the foreign investment attracted by good business environment is more 1.5 billion dollars.

Furthermore, based on the facilities and policies brought by dry port, inland cities can construct bonded areas and export processing zone successfully. Then dry ports are able to fully take the advantage of bonded areas and export processing zone. Under the background of “OBOR”, the operation of dry ports means inland cities improve their position when they doing business with foreign countries, which is required by the global economic strategic layout and future development.

2. International dry port takes the burden of industrial transfer

Nowadays, more and more industries transfer from coastal cities to inland cities. Convenient custom clearance procedure and acceptable logistics cost play an important role when different industries choose inland destinies. The construction of international dry port can support with efficient custom clearance procedure and low logistics cost, making inland cities become the attractive chooses for all kinds of

industries.

3. International dry port can help with industrial upgrading

Setting international dry ports can provide logistics, information flow, capital flow, business flow with efficiency and convenient platforms, making the industries alongside the silk road achieve a breaking development. Furthermore, it can optimize all kinds of logistics resources, making them form into a scientific logistics network. Besides some traditional industries, some new industries would be stimulate by the setting of dry ports, for example, exhibition service, inspection and quarantine agencies, freight forwarding and offshore finance. All these contribute to the industry type diversification.

2.4.2 Dry port can help with improving the competitiveness of sea ports

Economic hinterland is the foundation for sea port to be survived and prosperous, so the influence of economic hinterland makes a great difference to the development of sea ports. To be more detail, the sea ports' development momentum comes from economic hinterlands' spread, business scale and vitality. The construction of dry ports can help the sea ports to expand the economic hinterland and increase the source of goods, supporting the virtuous cycle of sea ports. And for Chinese sea ports, the point mentioned above is significant, since the location of most Chinese sea ports are not so good and their attraction is limited.

2.4.3 The impact of dry port on the carrier and the shipper

1. The impact of dry port on the carrier

Freight forwarding agencies, shipping companies are able to set branches in dry ports, and by doing this, it is convenient for them to gather containers, return containers and issue bill of lading. Through this way, freight forwarding agencies, shipping companies can service shippers directly, expanding customer resource.

2. The impact of dry port on the shipper

Without dry port, inland export companies need to go to sea ports when they deal with custom clearance issues. If they meet some special situation, they might travel

between sea ports and inland cities more than once. All of these not only waste human and material resources, but also delay the time for goods to be consumed. On the contrary, if dry port is available in inland city, inland export companies can do custom clearance in dry port, saving time and cost. For example, before Shijiazhuang set the dry port, local companies needed to go to Tianjin port to do custom clearance procedure. Besides, only after the cargo onboard the ship can they get export rebate, it needed more than 40 days. If company wants to modify the bills after they finish custom clearance, they need to go back to Tianjin port again. But the situation was totally changed after Shijiazhuang set the dry port. The time for custom clearance procedure was shortened to 10 minutes, and it only cost 7 days for companies to get export rebate.

Chapter 3 Dry port formation mechanism

3.1 The development of major dry ports along the “OBOR”

3.1.1 Nanning international dry port

Nanning City is located in southwest China. The pace of dry ports construction is accelerating. There are two reasons. One is to strengthen business relationship with Qinzhou, Beihai, Fangcheng port. The other is to develop foreign trade with South Asia, Southeast Asia and other countries. December 22 of 2009, southwest China's largest dry port - Nanning Bonded Logistics Center achieved the national comprehensive inspection, marking Nanning become regional logistics centre which aims at ASEAN.

May 28 of 2009, Nanning Bonded Logistics Center officially started to build, its planned area is 19.09 square kilometers. It not only is the core of China - ASEAN International Logistics Base, but also is the first phase of construction projects. It owns 2929 hectares bonded area with a total investment of about 10 billion yuan, including customs bayonet, office service area, customs inspection zones, bonded logistics zone. To build a dry port, Nanning inputted the human, material and financial resources that other cities cannot compared with. It only cost 288 days from the project is approved to it is accepted.

Nanning Bonded Logistics Center transportation is very convenient, north side is Hunan, Guangxi double-track railway and highway around the city, west side is the Silversea road which plays an important role in north-south major city, east side is the secondary main road of city, northeast side is Yu Dong train Station, south side is 30 kilometers to Wu Hao international airport, about 22 kilometers from the city center, the overall traffic obvious advantages. Currently, many companies take the first stationed in Nanning Bonded Logistics Center, which includes Guangxi COSCO International Freight Co. and other eight shipping companies, Sinotrans Group

Guangxi Branch and other five logistics companies, Foxconn Technology Group and other two companies.

The establishment of Nanning Bonded Logistics Center can effectively promote Guangxi Beibu Gulf Economic Zone and other modern logistics industry linkage development, accelerate the speed of foreign trade cargo transshipment in the southwestern region of Guangxi and its hinterland, enhanced coastal port international container supply aggregation ability. After the operation of Nanning Bonded Logistics Center, Nanning will be based on Guangxi to radiate surrounding provinces. Nanning dry port offers service for ASEAN countries as well as other countries and regions, and provides logistics activities for material of production and living.

3.1.2 Changchun international dry port

Changchun inland port located in Changchun East Station, covering an area of nearly 200,000 square meters, and its predecessor is Changchun rail freight port. Inland port infrastructure construction is divided into two phases, designed annual throughput is up to 150,000 to 200,000 TEUs, invested 400 million yuan or more. The four side co-construction includes the Changchun government, Dalian Government, Shenyang Railway Bureau and the Dalian Port Group. It is a harbor without water and boat. In addition to loading unloading, Changchun inland port has all the features of sea port: the ability to provide customers with the charter service, booking service, bill of lading offering service, container stuffing service and other harbor-specific services. It implements the extension of the harbor functions, achieving high-density, high efficiency linkage between dry ports and harbor transport, reducing the cost of inland transportation, ensuring the timely shipment and delivery of goods. Inland port can also provide import and export goods declaration, inspection and other customs services to enable enterprises in Changchun is able to do customs procedures in inland city.

The operation of Changchun dry port combines the advantage of Dalian port and the economic hinterland resource advantage of Changchun together, enhancing the

integration of regional logistics, achieving the seamless transportation and the linkage development between sea port and dry port. It takes full advantage of the policy advantages of Dalian bonded port. Policies and functions of the Dayao bay bonded port can be extended to Changchun, improving port services and the city overall competitiveness.

3.1.3 Yiwu dry port

Yiwu is the commodity distribution center, its material are supply from the mainland and the sales market is overseas, making Yiwu becomes the logistics key nodes status in the global supply chain. With the foreign trade continuous improvement in Yiwu, the building of dry port becomes the realistic choice of Yiwu.

Yiwu dry port consists of the Yiwu international logistics center and Yiwu inland port. Yiwu dry port (Yiwu International Logistics Center) located in the junction of Xuefeng road and airport road, 4 km away from the Hangzhou Jinhua Quzhou Expressway exit, 5 km away from the Kim Yong Highway Exit, 3 km away from civil aviation airport. The project has a total area of 450 acres, investment of 2.5 billion yuan. The dry port's throughput is the amount of 10 million TEU, and the area is divided into container yard area, storage area and office area.

Facing the rapid development of Yiwu foreign trade, original 10 million TEU through capacity for international logistics center cannot adapt to the development of container volume. Therefore, Yiwu starts the building of inland port station. The project is located in Yiwu city, near Yin Hai road, the project is divided into two phases, the total investment is 22 billion yuan. First phase is 616.4 acres, second phase is 995 acres. First phase of the project started in December 2007. Its function is similar to the Yiwu international logistics center, including yard, storage and office functions. After the completion of the entire project, it can meet the operating requirements of the 1000000 standard containers.

Yiwu established Jinhua customs Yiwu office in October 2002, the purpose is to handle small commodity declaration business. Before, although companies can handle

customs clearance of small commodities in Yiwu, but companies still needed to go to Jinhua to do reduction duty-free. July 2006, Jinhua customs Yiwu office and the Yiwu international logistics center signed an agreement about setting the logistics center warehouse to become a customs supervision warehouse. The agreement makes sure the Yiwu international logistics center and Shanghai port, Ningbo port truly achieves "off-site customs, port clearance". Yiwu international logistics center preliminary has the function of dry port. Yiwu customs was established in July 15, 2009, becoming the first independent customs of the county-level cities, and Yiwu truly realized the function of dry port.

Yiwu international logistics center is full financial invested by Yiwu government, and the Investment Company of Yiwu is responsible for the construction. It combines with a third party logistics and the fourth party logistics mode, and the dry port has the customs, inspection and quarantine and more than 30 international freight forwarding enterprises, the container transport operations of shipping and freight forwarding company are worldwide.

The China Shipping Group, CMA, China Taiwan Evergreen Marine, and other 15 shipping companies set branched in Yiwu International Logistics Center and carry out the international shipping business. The Shanghai Oriental International Group, PENAVICO Ningbo, Zhiyuan shipping, Fanyang shipping and other more than 60 international freight forwarding enterprises stationed in the center and do their business. Undoubtedly, customers in the center can enjoy safe, fast, accurate and convenient service.

3.2 The driven power behind dry port construction

The formation and development of international dry ports needs specific environment and conditions. An in-depth study of the driven power behind dry port construction has important significance. Considering theory and practice all over the world, the paper argues that the driven power behind dry port lies in the following

three aspects.

3.2.1 The need for the rapid development of the export-oriented economy in inland areas

The export oriented economy is the result of the development of the international economic relations to a certain stage. In the condition of commodity economy, both of the international division of labor and the unbalanced development of regional economy enhance the international economic relations. To change the economic situation of a country or region, it is necessary to make an international intercourse and make use of the advantages of other countries to make up for their shortage. In 1987, World Bank made a state statistical investigation about export-oriented economy and inward looking economic, it showed that GDP growth rate and manufacturing employment share of total employment percentage index in export-oriented economies countries were much higher than that in import-oriented economies countries. The development of export-oriented economy is the trend of world economic development.

According to the different dominant force of inland places, the driven power of dry port construction can be divided into 2 kinds: the dry port leading by government and the dry port leading by inland enterprises. A detailed introduction will be shown.

1. The dry port is leading by inland regional government.

Because of the important role of the export-oriented economy to the economic development of our country, inland region government takes various measures to promote the development of the export-oriented economy to speed up the development of economic. The building of dry port is one of the important measures.

However, the construction of inland port cannot be done by the subjective intention, but also requires inland regions have the necessary conditions. This will determined whether the inland port can successfully established, dry port scale and function orientation, and other important issues.

The following factors are important in the formation of the dry port leading by

the inland regional government:

(1) Inland regional economic scale and development potential

The scale of economy in inland region, especially the export-oriented economy is the key to the formation of land port. Large regional economies scale and promising foreign trade, means larger market demand. A larger market demand will attract logistics development companies to explore the dry port. And then, logistics companies will be attracted to construct logistics facilities, manufacturing enterprises will be attracted to construct dry port logistics distribution centers. Besides, business enterprises, wholesale and retail enterprises will be attracted to set up purchasing center. All of these enable the dry port arising huge gathering effect, so as to promote the formation of the international dry port. The potential of regional economic development is also a very important factor. If regional economic development has a big potential, the enterprise which will be settled in consider less short-term interests, and more long-term interests.

(2) The executive level of the government agencies, which are responsible for establishing the international land port

The government investment and coordination capacity is the key factor in dry port construction leading by government. And the amount of government investment and the scale of coordination depend on the executive level of government agencies which are responsible for the establishment of the dry port. Administrative level is higher, autonomy is greater, the more money can be got. The higher the administrative level, the better the coordination effect between the coastal port, the customs and the railway departments. Take Xi'an international port district as an example, at the beginning of Xi'an international port district project started in 2005, the responsible department for development of Xi'an international port district is Xi'an Huhe economic development zone, subordinate to Ruhe bridge area of Xi'an. Compared with other development zone in Xi'an, administration specification is low, which seriously restrict the development of Xi'an international port district. From 2005 to

2007, the Xi'an international dry port project was basically at a standstill.

Until 2008, Xi'an international port zone was upgraded as Xi'an municipal government agency. After the upgrading of the administrative committee of the Xi'an international port area administration, the Xi'an international port area has been developed rapidly. 2008 Xi'an International Port Zone Investment 6 billion yuan, fully launched the Xi'an international port area park infrastructure. Also strived by Xi'an International Port Zone, China railway international container Co., Ltd. invested 6.36 billion yuan to establish Xi'an railway container center station.

Under the efforts of Xi'an International Port Zone, Xi'an City, Shaanxi province government, in December 2008, the State General Administration of customs, Ministry of finance, the State Administration of Taxation, foreign exchange bureau approved the establishment of bonded logistics center in Xi'an. In June 2009, the first bonded logistics center project in Xi'an started its construction in northwest region. In April 2010, Xi'an bonded logistics center passed the joint inspection of the General Administration of customs and other ministries. In July 2010, Xi'an bonded logistics center was approved by the national government. The construction speed of the Xi'an international port area is obviously accelerated. This shows that the higher administrative should be given a certain level of building management right.

2. The dry port leading by inland enterprises.

Along with the continuous development of inland economy and the industries transfer, the import and export business of inland region is gradually increasing, and the momentum of development is rapidly. As the important position in the import and export logistics system, dry port will play a more and more important role, and has good investment prospect. Some companies are acutely aware of the investment in the dry port may bring investment returns, and begin to plan and construct dry ports. Take Houma dry port as an example, Houma dry port is constructed by Shanxi International Logistics Co., Ltd., the project investment 126 million yuan, designed annual throughput capacity is 600 million tons, complete with customs, entry exit inspection

and quarantine, banking, insurance, shipping and other departments.

The following factors are important in the dry port leading by inland regional government:

1) Inland international trade development level

If the level of international trade development in inland areas is not so good, it cannot form a certain size of container supply. For the business enterprise, the coastal port won't have too much enthusiasm to cooperate with this kind of dry port. The railway departments will not offer support for their own interests. In this case, even if there are local government support, will also make the operation of land port into trouble.

2. Enterprises economic power

International dry port need to invest a lot of money in the planning and preparation process. Even after the completion of the construction, the initial operation will be insufficient profitability, which needs to continue invest money. If the enterprises economic strength is strong, can carry on the initial investment, it is possible to pass the difficult period, and finally ushered in the dry port of profitability. In contrast, if the enterprise is lack of strength and lack of funds, cannot continue to invest, it will bring difficulties to construction and initial operation of dry port and influence the international land port development prospects.

3. Government support

Dry port is logistics infrastructure, so generally investment payback period is relatively long and is a certain public welfare. If local government consider the dry port as the public infrastructure attributes and gives greater support on the construction and initial operation period, will help in the international land port formed strong competitiveness and vitality. If the local government supports are limited, the international land port will face a certain operational risk.

3.2.2 Needs of coastal ports to expand inland hinterland

With the rapid develop of the highway network and the railway network, the

inland traffic is more and more developed, breaking the traditional hinterland belonged to different sea ports and forming a situation that multiple ports service to a same hinterland.

Along with the competition between the ports in the coastal areas keep upgrading, how to get a wider economic hinterland becomes the most concern for all sea ports. In recent years, many sea ports invest dry port in independent investment way or in joint venture way, and take this as an important means of expanding inland hinterland supply.

Take Ningbo port as an example, Ningbo port located in the middle of China's mainland coastline, and it is China's famous deep-water port. In recent years, the development of Ningbo port is rapid, container throughput of 2014 is more than 3 million boxes, ranking second in mainland china. According to the geographical position of Ningbo port and the container transport market structure, hinterland of container transportation of Ningbo port including Zhejiang, Shanghai, Jiangsu, Anhui, Jiangxi, Hubei, Hunan, Sichuan, Chongqing and other provinces and cities. Jiangsu, Zhejiang and Shanghai are as the direct economic hinterland, and the rest of the cities are the indirect economic hinterland. Most hinterlands and cities of Ningbo port are developed, level of opening up is relatively high, which provides an adequate supply of foreign trade container in Ningbo. Although the development of Ningbo Port is fast, Ningbo port also faces intense competition, Ningbo port is only 200 nautical miles far from Shanghai Port. Ningbo port and Shanghai port share the same hinterland, the competition of Shanghai port is becoming increasingly fierce. At the same time, Shanghai port investment heavily in the construction of Yangshan Deepwater Port, channel depth reached 15 meters, can berth the fifth and sixth generation container ships, this also weaken the deep-water port of Ningbo port. In addition, the competitiveness of Zhejiang local port is strengthened, such as Wenzhou port, so that the direct hinterlands of Ningbo port are divided. Therefore, Ningbo port not only develops the sailing route, but also actively develops hinterland. The construction of

dry port is an important measure.

To improve the competitiveness of the port, Ningbo port actively cooperated with inland cities in the construction of dry ports, and the results were significant. Since 2002, Ningbo port participated in the joint venture construction of Jinhua dry port. Since now, Ningbo port has established Jinhua, Yiwu, Shaoxing, Yuyao and Hengzhou dry ports, greatly promoted the local economic development, bringing a large number of sources for Ningbo port.

3.2.3 The product of the practice of regional customs clearance reform

Under the tide of regional economic integration, the customs follow the guiding principle of service economy and promote the development, begin regional customs clearance reform. Regional clearance reform, is the require for the customs to fully implement the party's sixteenth session of the Sixth Plenary Session of the regional economic development, as an important measure to promote the building of a harmonious socialist society, to enhance the ability of the customs service, is the inner need of promoting the construction of customs modernization. The implementation of regional customs clearance mode is important to simplify customs clearance procedures for the inland provinces and regions, reduce logistics costs, and promote the development of regional foreign trade. It breaks the current administrative divisions and obstacles of customs, distinguish powers and responsibilities of coastal and inland customs reasonably. It also stimulates organic interaction of customs clearance and supervision work. Compared with the traditional transit customs clearance mode, the regional customs clearance mode is more respect for the laws of logistics, process easier, truly achieves "a declaration, an inspection, a release," maximally reduces customs intervention of logistics, actually builds an unimpeded clearance high-speed road.

Take Tianjin custom as an example, based on the running of the "territoriality declaration, port clearance" clearance mode, Tianjin custom launched the first "当 dry port" customs clearance mode after a thorough investigation, collecting and analyzing

the demand of business related to inland enterprises. The model establishes a logistics center in the inland areas with customs declaration, inspection, issue bills of lading and other port service functions, and then connects the dry port by rail or road transport. Besides, this model set customs, inspection and quarantine and other regulators in the "dry port". Branches for freight forwarding company, shipping company are also available in dry port. Except port loading and unloading operation, the function of the dry port is basically the same as harbor. This shows that the practice of regional custom clearance reform is an important reason for the formation of the international dry port.

3.3 Different formation processes of the dry port

Dry port is a comprehensive logistics node which has the function of international and domestic logistics service. It is the result of the integration of logistics functions. Through the analysis on the existing dry ports' formation processes, this paper argues that it has five formation ways: formation relies on the container transfer station, formation relies on the logistics park (Logistics Center), formation relies on inland port, formation relies on the professional market or economic park, formation relies on transportation hub.

3.3.1 Formation relies on the container transfer station

Container transfer station is an important distribution point in the process of container transportation, which is the extension of container ports in inland areas. Be armed with container transfer station, the shippers of the vast inland areas do not need to transport the goods to the port terminal yard separately, and only need to sent the container goods to the nearby container transfer station, the transit station gathers all the cargo in small size and stuff them in containers together, then transport full containers to container yard by container trucks or trains.

Although the Container Transfer Station plays an important role in relief port collecting and distributing pressure, inland consignors deal still exist a lot of

inconvenience with custom clearance. Container transfer station is divided into highway container terminal and railway station. Highway container transfer station does not have clearance function, cannot do custom clearance procedures, so import and export goods must do custom clearance in the coastal department, this causes great loss of time and cost. And to railway container transfer station, although some transit station can achieve clearance, the goods still need to do secondary procedures at coastal port, which increases the cost of the owner.

To promote more profit, some container transfer stations which do not have function of clearance, begin to develop clearance functions. Some transfer stations which already have clearance function try to achieve finished goods clearance in transit station, and do not need to do secondary clearance procedures in port or border under the support of the customs and coastal port. After the integration of functions, the transfer station has evolved into a dry port, which has the comprehensive functions of container terminal, port supervision and so on.

3.3.2 Formation relies on the logistics park

Logistics park is an area that concentrated with logistics operation, which places a variety of logistics facilities and different types of logistics enterprises in a certain area. Besides it is a point which has a certain scale and logistics enterprises with a variety of services.

Some of the logistics parks located in the inland developed areas. As the rapid development, transportation, warehousing, packaging and other basic logistics functions are hard to meet the needs of import and export enterprises. Import and export enterprises hope to get custom clearance service, bonded warehousing service at logistics park. Promoted by the real need of import and export enterprises, some of the logistics parks begin to expand their own logistics service function. They attract customs, inspection and quarantine departments and other institutions, gradually evolved into the dry port, which is armed with the function of bonded warehouse, export supervision, container business, international freight forwarding.

3.3.3 Formation relies on inland port

The port means the country's coastal ports. With the development of transportation layout, the goods of foreign trade can get to a country hinterland directly through the railway and air. To support these goods be transferred fluently, China set many port. In brief, the port is the gateway to the country designated to develop foreign trade, is the international cargo transport hub. To some extent, it is a special kind of international logistics node.

As an international logistics node, traditional land port' function is relatively simple, which provides customs clearance service mainly. In order to provide integrated logistics services to the import and export business, some ports with a large amount of cargoes expand the regional logistics industry and the functions of warehousing, freight forwarding, distribution and other logistics functions. Through the function expansion, some inland port gradually evolved into dry ports.

3.3.4 Formation relies on the professional market

The history of professional market is very long. In China, there are professional market records as early as in the Tang Dynasty. After the founding of new China, the country restricted the development of private sector, and the professional market, were all cancelled. After the reform and opening up, the professional market began to develop gradually. For large professional markets, their trading volume and freight demand are large, so their logistics demand are very large. some dry ports is format based on the professional markets. Yiwu international logistics center is a typical dry port, which is based on the small commodity market. Yiwu small commodity wholesale market was founded in 1982, is one of the earliest professional market in our country, and its commodities were transported to more than 210 countries and regions.

Facing the global trade integration and the increasing import and export logistics demand in Yiwu, Yiwu international logistics center emerges. The huge import and export logistics volume of economic zone can provide support for the survival of the

dry port.

3.3.5 Formation relies on transportation hub

A transport hub (also transport interchange) is a place where passengers and cargo are exchanged between vehicles or between transport modes. Public transport hubs include train stations, rapid transit stations, bus stops, tram stop, airports and ferry slips. Freight hubs include classification yards, seaports and truck terminals, or combinations of these.

Transport hub has perfect transportation infrastructure, so goods are able to distribute quickly, being with good condition for the development of international dry port. Particular a number of large-scale railway hubs have the conditions for the development of container multimodal transport. Formation of many dry ports is based on the railway hub. It can make full use of the railway transportation cost advantage, improve the comprehensive competitiveness of land port and enhance attraction of the owner by the development of sea rail transportation.

Xi'an international port district is the international dry port that established relies on transport hub. With the cooperation with coastal port, Xi'an international port mainly depends on Xi'an container center station, Xi'an Xinzhu new railway bulk field and the surrounding railway, forming land-and-water coordinated transport concentration.

3.4 The problems existing in the linked development relationship between harbors and dry ports

Except some dry ports set to promote frontier trade, such as Zhangmu, Ruili, one of dry port purposes is to form a linked development relationship with harbors. Linked development relationship means objects within a certain geographic range break the original boundaries, and cooperate with each other according to the resources and functions owned maturely. These objects combined with each other and join market competition. The system's attraction and competitiveness would be

improved, besides, all objectives are able to get sustainable development and win-win situation. However, under the background of “OBOR” the development of linked relationship between dry ports and harbors exist some problems.

The problems are listed as follow:

Firstly, the attractive powers of most sea ports are limited. Except Shanghai and Zhengzhou, other sea ports influence powers are equivalent. In order to get more economic hinterland, they try all kinds of means at all costs, and even fall into vicious competition.

Secondly, dry port’s position is not clearly, making them can’t give full play to their function. To take the chance brought by “OBOR”, inland cities construct dry ports blindly. They aim at building comprehensive dry ports with big scale, ignoring the reality. This leads to build redundant project, waste resources. Since all these dry ports want to get more cargos and be the priority choice when sea ports choose cooperators, the situation would deteriorate into vicious competition.

Thirdly, dry ports do not have scientific stander when they choose cooperated sea ports. Since dry port’s strategic positioning is unclear, it is unable to choose suitable cooperated sea ports based on its locations, transportation facilities and economic base. For example, at the beginning of the building of Xi’an international dry port, the dry port authority chose Shanghai port as their partner. The reason is that Shanghai not only owns high throughput capacity, but also owns high transportation efficiency. However, as time pass by, Xi’an dry port authority noticed that setting Shanghai as their sea port partner costs a lot in transportation procedure. To deal with this problem, Xi’an changed their strategy, and set Tianjin port as their coordinator. By doing this, the logistics costs are reducing, besides, the transport time are shortened.

Forthly, administrative barriers are hard to be tackled. Different sea ports and dry ports belonged to different administrative areas. Different administrative areas fight for their own benefits, then administrative barrier arising. For their own benefits, they compete for projects, form regional protectionism. All these are not only bad for sea

ports make a joint effort with dry ports, but also bad for the two sides to make efficient communication, hindering the two sides to form a profound interacted related formerly.

Fifthly, low efficiency exists in changing different types of transportation modes. The operation of dry port involves many transport modes. Firstly, inland cargos need to be transported to the train station by truck. Then trains pass the cargo to the sea port. Finally, the cargo will be onboard the ship and be set to abroad. Because of many obstacles, seamless transportation is hard to be achieved. For example, different transport modes have different management regulations, besides, the bills are also different.

Sixthly, logistics information platform are deficiency. Dry port requests that different logistics activities have to interact with each other effectively. And a powerful logistics information platform is essential in this procedure, since logistics information platform is the precondition of the linkage development relationship between sea ports and dry ports. Some place have been armed with logistics information platform for a long time, however it is too underdeveloped to support the requirement. The deficiency of logistics information platform leads sea ports and dry ports can't communicate with each other smoothly, causing low logistics efficiency and sea port conjunction problems eventually.

Chapter 4 Research of the gravity model between inland city and port city

In the course of the development of the international dry port, the coastal port is playing an extremely important role. The logistics system that are constructed by the dry port and sea port have great effects on the circulation efficiency of the goods, the development level of the inland and seaport cities, as well as the international competitiveness of the whole country. In order to overcome the harbor and dry port linkage development existing problem, offering reference for native and sea port authorities, this chapter proposed establishes a model between inland cities and sea ports. The purpose of this model is to explore the inland port and the sea port logistics association, and find out the core city and logistics network.

4.1 City and port foreign trade logistics gravity model

Gravity model is derived from Newton's law of universal gravitation, that is, any two objects exists gravitational force, the size of which is proportional to the product of their mass, and is inversely proportional to the square of their distance. Gravitation is widely used in modern economics and management. Since the economy is different from the general object, universal gravitation formula is modified according to the reaties, and some of the variables are redefined.

Port is foreign exchange portal that specified by country, is the hub of the transport of goods in international trade, is a kind of special international logistics node. Cities and ports attract each other to form logistics integration, and then form the foreign trade logistics network. According to the gravity model, this model should have the following two basic elements:

4.1.1 The basic driving force of gravity - the amount of imports and exports

1. The amount of imports and exports volume happened in coastal cities within a

certain period of time. A large city has more import and export supplies than the smaller cities, has greater attract in supply of goods to the port.

2. Import and export volume happened in inland cities in a certain period of time. Inland cities with large cargo volume will have a greater attraction power to port cities.

4.1.2 Distance

The core idea of the gravity model is distance decay principle. The so-called distance decay principle is that the intensity of the interaction between the various objects keeping decreasing with the increase of the distance between each other. Therefore, the attraction between the city and the port can be reflected by the distance between the city and the port.

P_i ($i=1,2,\dots,m$) means total import and export volume of each sea port in a certain time, Q_j ($j=1,2,\dots,n$) means total import and export volume of each inland city in a certain time. D_{ij} means the distance between each city and port. Thus, foreign trade logistics gravity of any city and port will be expressed formula 4-1, that is:

$$F_{ij} = k \frac{P_i Q_j}{D_{ij}^2} (i = 1, 2, \dots, m, j = 1, 2, \dots, n, \quad (4-1)$$

In the formula, K is the adjustment parameter. According to different research objects, in addition to the import and export trade value and distance, the influence of other factors on inland city and port are different, so K value should be determined according to the actual influence factors.

4.2 Gravity model between inland city and port city

Coastal port is of the most importance in foreign trade. According to statistics, 80% of the volume of international trade is done by shipping. Coastal port is responsible for shipping and inland transportation reasonable convergence, ensuring the

continuity of foreign trade logistics.

In order to make the foreign trade logistics gravity model of be more suitable for the practical research, the gravity formula is corrected. The following factors should be considered:

Firstly, throughput of sea port should be considered. The harbor relies on its throughput becoming a combination of sea and land economy. Harbor attracts inland sources by its size and function. Throughput in a period of time is an important index to measure the strength of a sea port. Therefore, put foreign trade throughput of sea port into consideration when studying the gravity between sea port and dry port, relevant parameters notes for t_i .

Secondly, inland city import and export volume accounted for import and export volume of sea port should be considered. Inland city import and export volume accounted for import and export volume of sea port can illustrate the importance of inland cities' supply to the harbor. So it should be took into consideration when studying the gravity between sea port and dry port, named as S_{ij} .

$$S_{ij} = \frac{q_j}{p_i} (i = 1, 2, \dots, m, j = 1, 2, \dots, n), \quad (4-2)$$

Among them, q_j means the total import and export volume of a certain period of inland cities, p_i means the total import and export of coastal ports in a certain period of time.

S_{ij} and t_i are proportional to the gravity model between sea port and dry port. The importance to the model is expressed by the exponential change of the index. Through a lot of research of realities, change parameter k to $k_{ij} = t_i \times S_{ij}^2$ to make the whole model do better in reflecting the reality. So the gravity model between sea port and dry port are modified as below:

$$F_{ij} = k_{ij} \frac{P_i Q_j}{d_{ij}^2} (i = 1, 2, \dots, m, j = 1, 2, \dots, n, \quad (4-3)$$

In the formula, d_{ij} means the distance between inland city and harbor.

4.3 The amount of gravity between sea port and dry port

4.3.1 The selection of relevant factors

1. The selection of sea ports

As an important infrastructure of national economy and social development, coastal port supports the development of international trade and economy effectively. China has more than 150 coastal ports, which transit more than 90% domestic foreign trade goods, and from this aspect, sea ports can be considered as an important force affecting the rapid development of regional economy.

A research group, which belongs to Institute of world economics Dalian Maritime University, studied the comprehensive competitiveness of the 60 ports in China from 5 aspects which includes investment trends, throughput growth rate, capacities of port operations, port financial position and natural conditions. The study has been highly approved in china, so the top 10 sea ports are chose to be the research objects in this dissertation. These sea ports include Shanghai port, Shenzhen port, Ningbo-Zhoushan port, Qingdao port, Guanzhou port, Tianjin port, Dalian port, Xiamen port, Yingkou port, Lianyungang port.

2. The selection of dry ports

Second session of the Asia transport ministers' forum was hold in Bangkok in 2013. 14 member countries included China signed the "Intergovernmental Agreement on Dry Ports" in the session. The agreement pointed 270 inland cities belonged to all member countries to be dry port cities. 17 inland cities belonged to China were covered, and they are the main references in the dry ports selecting procedure. These cities include Changchun, Erenhot, Harbin, Hekou, Huoerguosi, Hunchun, Jinghong, Kashi, Kunming, Manzhouli, Nanning, Pingxiang, Ruili, Shuifenhe, Urumqi, Yiwu,

Zhangmu.

After reading large amount of references, Jinghong, Kashi, Ruili, Zhangmu are eliminated in the dry port selecting procedure, the reason is that these cities locate in boundary area and their main purposes are doing business with near countries, having little connection with sea port.

In order to support to the construction of “OBOR”, the silk road alongside cities embark to build dry ports accordingly. It is necessary to take those cities which are relatively outstanding in dry port building procedures into consideration. According to a large number of references, those cities include Lanzhou, Xi’an, Chaoyang, Shijiazhuang, Baotou, Shenyang, Zhengzhou, Shangrao, Daqing, Nanchang, Changsha.

3. The selection of distance between sea port and dry port

The core idea of gravity model is that the gravity keeps reducing as the distance increases, so distance is a significant factor that can decide the amount of gravity between sea port and dry port. Railway is the most economical transportation mode, so to achieve high economic efficiency and to release high way conjunction problem, in the longer term, railway will be the main transportation mode. Based on former analysis, the distance between sea port and dry port selected by the dissertation is the shortest railway distance between two sides.

4. The selection of other factors

Throughput is an important index when measuring the strength of harbors. The throughputs of different sea ports are listed in table 4-1. According to the request of gravity study, the biggest throughput is set as numerator, and the others are set as denominator. The results of these computes are the value of t_i .

Table 4-1 the throughputs of different sea ports and values of t_i

	Throughput (Million tons)	t_i
Shanghai port	7.36	0.989247312
Shenzhen port	2.01	0.27016129
Ningbo-Zhoushan port	7.44	1
Qingdao port	4.02	0.540322581
Guanzhou port	4.34	0.583333333
Tianjin port	4.76	0.639784946
Dalian port	3.73	0.501344086
Xiamen port	1.72	0.231182796
Yingkou port	3.01	0.404569892
Lianyungang port	1.85	0.248655914

Data resource: “China port Yearbook”

Then the values of s_{ij} are required. The data needed is both of dry ports’ and sea ports’ total volume number of foreign trade happened in 2012. Putting all of these data into formula 4-2, the results are list in table 4-2.

Table 4-2 the results of s_{ij}

	Shang hai port	Shen zhen port	Ningbo- Zhousha n port	Qingda o port	Guan zhou port	Tian Jin port	Da lian port	Xia men port	Ying kou port	Lian yungang port
Erenhot	0	0	0.02	0.03	0.02	0.02	0.04	0.03	0.36	0.25
Hekou	0	0.01	0.03	0.05	0.03	0.03	0.08	0.05	0.66	0.46
Hunchun	0	0	0.02	0.03	0.02	0.02	0.04	0.03	0.38	0.26
Manzhouli	0	0	0.02	0.03	0.02	0.02	0.05	0.03	0.4	0.27
Pingxiang	0.01	0.02	0.06	0.1	0.06	0.06	0.15	0.1	1.3	0.89
Shuifenhe	0.02	0.03	0.11	0.17	0.11	0.11	0.27	0.17	2.31	1.58
Changchun	0.02	0.04	0.18	0.27	0.17	0.17	0.43	0.26	3.59	2.46
Harbin	0.01	0.01	0.04	0.06	0.04	0.04	0.1	0.06	0.84	0.58

Kunming	0.02	0.03	0.13	0.2	0.12	0.12	0.31	0.19	2.62	1.8
Nanning,	0.01	0.01	0.04	0.06	0.04	0.04	0.09	0.06	0.76	0.52
Urumqi	0.01	0.02	0.09	0.14	0.09	0.09	0.23	0.14	1.89	1.3
Lanzhou	0	0.01	0.03	0.05	0.03	0.03	0.07	0.05	0.62	0.42
Xi' an	0.02	0.03	0.12	0.18	0.11	0.11	0.28	0.17	2.37	1.63
Chaoyang,	0.22	0.38	1.58	2.41	1.51	1.53	3.83	2.37	32.16	22.08
Shijiazhuang	0.02	0.03	0.12	0.18	0.11	0.11	0.28	0.17	2.36	1.62
Baotou	0	0	0.02	0.03	0.02	0.02	0.05	0.03	0.38	0.26
Shenyang	0.02	0.03	0.11	0.17	0.11	0.11	0.28	0.17	2.32	1.59
Yiwu	0.03	0.05	0.2	0.31	0.19	0.2	0.49	0.31	4.14	2.84
Zhengzhou	0.04	0.08	0.32	0.49	0.31	0.31	0.78	0.48	6.53	4.48
Shangrao	0	0.01	0.02	0.04	0.02	0.02	0.06	0.04	0.49	0.34
Daqing	0	0.01	0.03	0.04	0.02	0.02	0.06	0.04	0.51	0.35
Nanchang	0.01	0.02	0.07	0.11	0.07	0.07	0.18	0.11	1.51	1.04
Changsha	0.01	0.02	0.08	0.12	0.07	0.08	0.19	0.12	1.58	1.09
Huoberguosi	0.01	0.01	0.05	0.08	0.05	0.05	0.12	0.08	1.04	0.71

Data resource: "China Urban Development Yearbook"

4.3.2 Gravity calculation

According to the formula 4-3, the gravity calculation results are listed in table 4-3.

Table 4-3 the result of gravity value

	Shanghai port	Shenzhen port	Ningbo-Zhoushan port	Qingdao port	Guanzhou port	Tianjin port	Dalian port	Xiamen port	Yingkou port	Lianyungang port
Erenhot	0.21	0.13	0.03	0.02	0.03	0.03	0.01	0.02	0.00	0.00
Hekou	0.62	0.36	0.09	0.06	0.09	0.09	0.04	0.06	0.00	0.01
Hunchun	0.12	0.07	0.02	0.01	0.02	0.02	0.01	0.01	0.00	0.00
Manzhouli	0.12	0.07	0.02	0.01	0.02	0.02	0.01	0.01	0.00	0.00
Pingxiang	8.22	4.79	1.15	0.75	1.20	1.19	0.47	0.76	0.06	0.08

Shuifenh	25.19	14.68	3.52	2.30	3.68	3.63	1.45	2.34	0.17	0.25
Changdun	171.21	99.74	23.92	15.64	25.03	24.69	9.85	15.92	1.17	1.71
Harbin	1.83	1.07	0.26	0.17	0.27	0.26	0.11	0.17	0.01	0.02
Kunming	52.36	30.50	7.31	4.78	7.66	7.55	3.01	4.87	0.36	0.52
Nanning	2.10	1.22	0.29	0.19	0.31	0.30	0.12	0.20	0.01	0.02
Urumqi	8.35	4.86	1.17	0.76	1.22	1.20	0.48	0.78	0.06	0.08
Lanzhou	0.91	0.53	0.13	0.08	0.13	0.13	0.05	0.08	0.01	0.01
Xi'an	119.51	69.62	16.69	10.92	17.47	17.23	6.88	11.11	0.82	1.19
Chaoyang,	319677.32	186227.91	44653.23	29203.52	46742.88	46097.32	18396.65	29719.91	2190.98	3192.18
Shijiazhuang	135.60	79.00	18.94	12.39	19.83	19.55	7.80	12.61	0.93	1.35
Baotou	0.24	0.14	0.03	0.02	0.04	0.03	0.01	0.02	0.00	0.00
Shenyang	57.61	33.56	8.05	5.26	8.42	8.31	3.32	5.36	0.39	0.58
Yiwu	17996.02	10483.58	2513.72	1643.99	2631.36	2595.02	1035.63	1673.06	123.34	179.70
Zhengzhou	5714.97	3329.26	798.28	522.08	835.64	824.10	328.88	531.31	39.17	57.07
Shangrao	9.93	5.79	1.39	0.91	1.45	1.43	0.57	0.92	0.07	0.10
Daqing	0.45	0.26	0.06	0.04	0.07	0.06	0.03	0.04	0.00	0.00
Nanchang	129.46	75.42	18.08	11.83	18.93	18.67	7.45	12.04	0.89	1.29
Changsha	69.65	40.57	9.73	6.36	10.18	10.04	4.01	6.47	0.48	0.70
Huoerguosi	1.02	0.59	0.14	0.09	0.15	0.15	0.06	0.09	0.01	0.01

4.4 Analysis of inland city -port trade gravity result

4.4.1 Related concepts of social network analysis

"Network" is a kind of relationship between things. "Social network" is a collection of social objects and their relationships. A social network is made up by a collection of multiple points (social actors) and the connection between each point (representing the relationship among the actors).

The social network analysis method is used to study the relationship between different objects and actors, and to measure the level of "relationship". The method studies the social network by using matrix theory and graph theory, and it gets the structure of social relations by the corresponding quantitative research software technology, it studies social phenomenon and social structure from the "relationship" angle. UCINET has a very strong matrix analysis function, is the most widely used social network analysis software in currently.

1. The mode of network

The network make up by the relations between all objects within one set called "1-mode network", "2 - mode network" is the relationship between a set of objects and a set of events. The analysis of the gravity model between sea port and dry port is a typical 2- model network.

2. The density of the network

In undirected network, if the number of objects is n , then the maximum possible value of the total relationships within the in theory is $\frac{n(n-1)}{2}$, if the relation number contained in the network is m , then the network density is $\frac{m}{\frac{n(n-1)}{2}}$. Overall, the greater network density, the greater impact of the network on the behavior of the actors.

3. Centrality analysis

(1) Degree centrality. In 2- mode network, the degree centrality is the number of events that the objects belonged to, an event' degree centrality is the number of objects in the event. Usually, an object's relative degree centrality is the events belonged by the object divided by the total number of events. An event's relative degree can be got according to the same way.

(2) Closeness centrality. For 1-mode network objects, the closeness centrality is the distance of one object to other objects, and for 2-mode network. It is equal to the sum of distance between one object to other objects adds the sum of the object to all

events and distance, the formula is showed as 4-4, empathy can calculate closeness centrality of an event.

$$C_c^{NM}(n_i) = 1 + \frac{a_{j=1}^{0g+h} \min d(k, j)^{-1}}{g+h-1} \quad (4-4)$$

In the formula, g is object number, h is event number, event k is connects to point i

(3) Center centrality. In 2 - mode network, because each couple of objects need to participate in various events to achieve communication, so the event is always in a shortcut between objects. Similarly, the actors are always in shortcut between events. Taking into account all the objects belonging to the event when calculate the center centrality of an event which noted MK. A couple of objects noted (ni,nj) merely share an event noted mk ($x_{ij}^N = 1$), then MK center centrality will increases a unit. If a pair of objects (ni,nj) merely share x_{ij}^N events, then MK center centrality increases $\frac{1}{x_{ij}^N}$ unit.

(4) Core/periphery structure analysis. The core/periphery structure is a important structure in reality, which mainly exists in two kinds of objects: core actors and edge actors. Using the core/periphery structure to analyze the 2- model, the block with high density and low density can be found on the main diagonal. "Core" is a high density block, which is composed by a number of objects and events, and the objects are closely related to the event. Therefore, the "core" is a cluster, which includes strong link between the actors and the event. Periphery is the low density block, and the relationship between the objects and the events is weak.

4.4.2 Analysis of inland city –port trade logistics network gravity model

1. Dry port alternative city classification

For the eastern inland city of China, the city function is comprehensive, the overall strength is stronger, the distances to sea ports are near, and the equipment is perfect. Convenient transportation, low transportation led to superior conditions in the

establishment of international dry port. And these cities have large gravity to seaport, there for, they are suitable for planning to establish close international inland port. Central and west inland cities are far from seaport, so the gravity is smaller compare with eastern inland city. But they are fit for establishing long distance dry port. According to the classification of dry port, these cities are divided into the eastern part of the inland cities and the central and western parts.

(1) Eastern inland cities, include Hunchun, Suifenhe, Changchun, Harbin, Chaoyang, Shijiazhuang, Shenyang, Yiwu, Shangrao, Daqing. The gravity matrix of them to seaport is show as follow:

$$A = \begin{bmatrix} 0.12 & 0.07 & 0.02 & 0.01 & 0.01 & 0.02 & 0.007 & 0.01 & 0.00 & 0.00 \\ 25 & 14.67 & 3.52 & 2.3 & 3.68 & 3.6 & 1.45 & 2.34 & 0.17 & 0.25 \\ 171 & 99 & 23.91 & 15.64 & 25 & 24 & 9.85 & 15.91 & 1.17 & 1.7 \\ 1.82 & 1.06 & 0.25 & 0.167 & 0.26 & 0.26 & 0.11 & 0.17 & 0.01 & 0.02 \\ 17969510468125100164152627425911103411670512311794 \\ 135 & 78 & 18.94 & 12.38 & 19.82 & 19.55 & 7.81 & 12.6 & 0.93 & 1.35 \\ 57 & 33 & 8.04 & 5.26 & 8.42 & 8.3 & 3.32 & 5.36 & 0.39 & 0.57 \\ 17996 & 10483 & 2513 & 1643 & 2631 & 2595 & 1035 & 1673 & 123 & 179 \\ 9.93 & 5.78 & 1.38 & 0.90 & 1.45 & 1.43 & 0.57 & 0.92 & 0.68 & 0.099 \\ 0.44 & 0.26 & 0.06 & 0.04 & 0.06 & 0.064 & 0.03 & 0.04 & 0.003 & 0.01 \end{bmatrix}$$

When the gravity value is less than 5 means the gravity of eastern inland city and seaport is very weak, regarding it as invalid gravity. Otherwise, it will be regarded as the effective gravity. Effective gravity of inland city and seaport in the eastern part is shown in Figure 4-1, the city points listed in the left side of figure are regarded as invalid gravity.

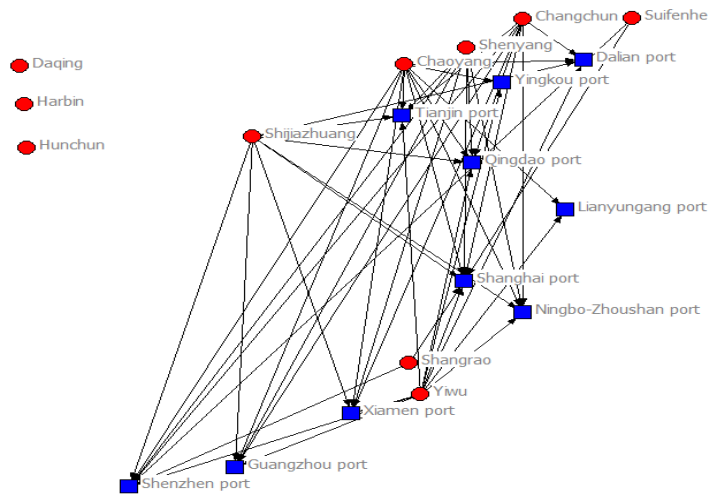


Figure 4-1 the effective gravity of eastern inland cities and ports

Because of the limitation of the multi - value matrix in the analysis of social networks, the gravity value of less than 5 is neglected, and binaryzation of the matrix A is recorded as A':

$$A' = \begin{bmatrix} 0000000000 \\ 1100000000 \\ 1111111100 \\ 0000000000 \\ 1111111111 \\ 1111111100 \\ 1111110100 \\ 1111111111 \\ 1100000000 \\ 0000000000 \end{bmatrix}$$

(2) Central and western inland cities, includes Erlian, Hekou, Manzhouli, Pingxiang, Kunming, Nanning, Urumqi, Lanzhou, Xi'an, Baotou, Zhengzhou, Nanchang, Changsha, Khorgos. The gravity matrix of them to seaport is show as follow:

$$B = \begin{bmatrix} 0.21 & 0.12 & 0.03 & 0.02 & 0.03 & 0.03 & 0.01 & 0.02 & 0.00 & 0.00 \\ 0.61 & 0.35 & 0.08 & 0.056 & 0.09 & 0.08 & 0.04 & 0.06 & 0.00 & 0.00 \\ 0.12 & 0.06 & 0.016 & 0.01 & 0.017 & 0.017 & 0.00 & 0.01 & 0.00 & 0.00 \\ 8.22 & 4.79 & 1.14 & 0.75 & 1.2 & 1.18 & 0.47 & 0.76 & 0.06 & 0.08 \\ 52 & 30 & 7.31 & 4.78 & 7.66 & 7.55 & 3.01 & 4.87 & 0.36 & 0.52 \\ 2.09 & 1.22 & 0.29 & 0.19 & 0.3 & 0.3 & 0.12 & 0.19 & 0.01 & 0.02 \\ 8.34 & 4.86 & 1.16 & 0.76 & 1.22 & 1.2 & 0.48 & 0.77 & 0.06 & 0.08 \\ 0.91 & 0.53 & 0.13 & 0.08 & 0.13 & 0.13 & 0.05 & 0.08 & 0.00 & 0.00 \\ 119 & 69 & 16.69 & 10.91 & 17.47 & 17 & 6.87 & 11.11 & 0.81 & 1.19 \\ 0.24 & 0.13 & 0.03 & 0.02 & 0.04 & 0.03 & 0.01 & 0.02 & 0.00 & 0.00 \\ 5714 & 3329 & 798 & 522 & 835 & 824 & 328 & 531 & 39 & 57 \\ 129 & 75 & 18 & 11 & 18.93 & 18.66 & 7.45 & 12 & 0.88 & 1.29 \\ 69 & 40.57 & 9.73 & 6.36 & 10.18 & 10 & 4 & 6.47 & 0.47 & 0.69 \\ 1.02 & 0.59 & 0.14 & 0.09 & 0.14 & 0.15 & 0.05 & 0.09 & 0.00 & 0.01 \end{bmatrix}$$

Empathy, analyze the distribution of gravity. To central and western inland cities, when the gravity value is less than 0.5 means that gravity of city and seaport is very weak, regarding it as invalid gravity. Neglecting the cities with less than 0.5 gravity values, efficiency gravity is as shown in Figure 4-1, and binaryzation of the matrix B is recorded as B':

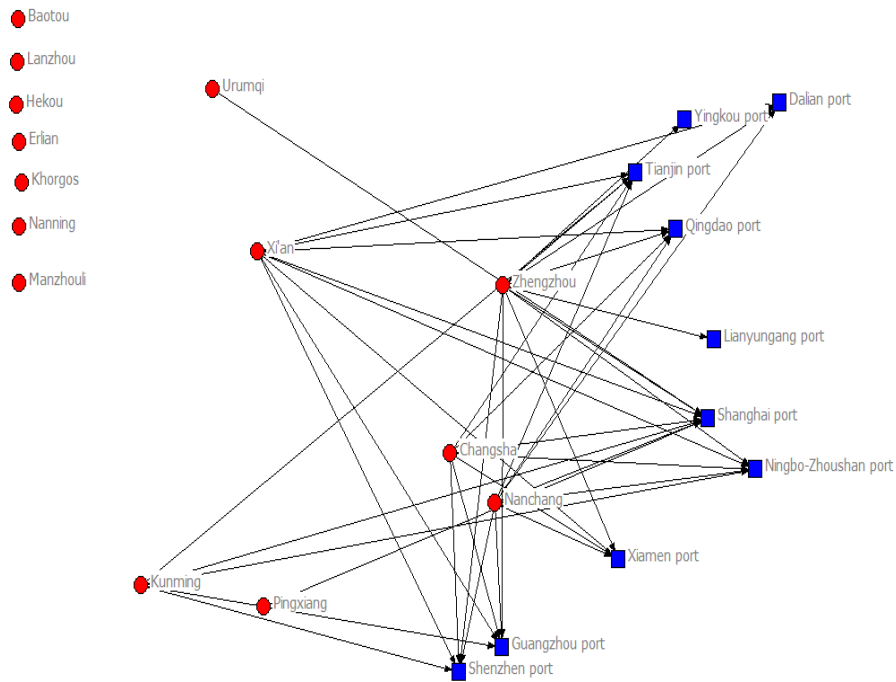


Figure 4-2 the effective gravity of central and western inland cities and ports

$$B' = \begin{bmatrix} 0000000000 \\ 1000000000 \\ 0000000000 \\ 1111110100 \\ 1111111101 \\ 1100000000 \\ 1111110100 \\ 1100000000 \\ 1111111111 \\ 0000000000 \\ 1111111111 \\ 1111111111 \\ 1111111101 \\ 1100000000 \end{bmatrix}$$

2. The centrality analysis of inland cities.

1) The centrality analysis of sea ports and east inland cities

Since the precise gravity value can't be reflected by the gravity network in section 4.4.2, so the centrality analysis needed to be done according to matrix A'. The analysis results are showed in figure 4-3 and figure 4-4.

2-Mode Centrality Measures for ROWS of jieguol			
	Degree	Closeness	Betweenne
Suifenhe	0.200	0.579	0.001
Changchun	0.800	0.846	0.076
Chaoyang	1.000	1.000	0.194
Shijiazhuang	0.800	0.846	0.076
Shenyang	0.700	0.786	0.054
Yiwu	1.000	1.000	0.194
Shangrao	0.200	0.579	0.001

Figure 4-3 the centrality analysis result of matrix A' (1)

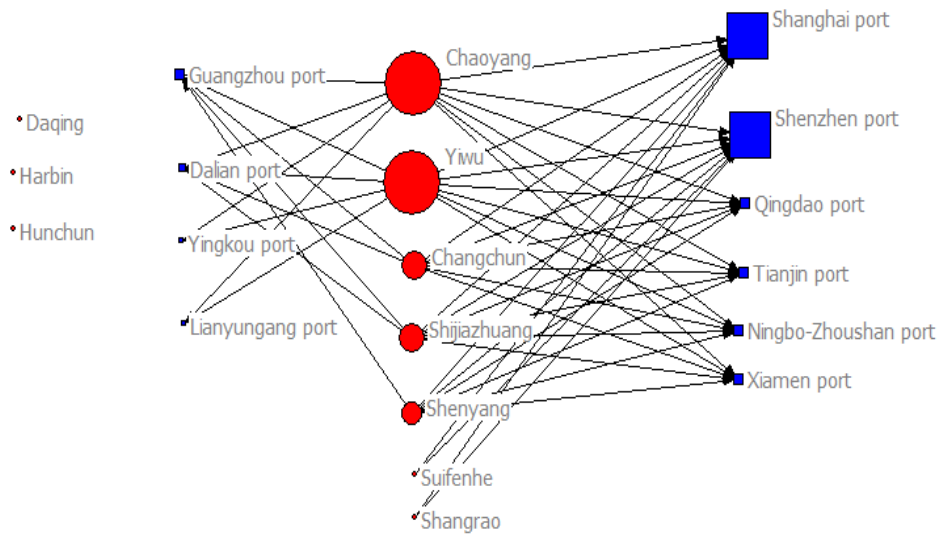


Figure 4-4 the centrality analysis result of matrix A' (2)

According to the figures, Chaoyang, Yiwu existing effective gravity with sea ports, and have more choices when they choose sea port cooperators. In these cities, shippers can choose the cooperated sea ports freely according to the destiny ports, types of goods, sailing routes and sailing schedule in different sea ports. Undeniably, they are the first choice to built comprehensive international dry port.

Changchun, Shijiazhuang, Shenyang are lower in centrality degree, so the choices are limited when they choose sea port cooperators. For these cities, dry port authorities should choose targeted sea port operators, improving its own competitiveness and attracting more cargos.

Some cities' centrality degree are very small, such as Shuifenhe, Shangrao. Since these cities' total foreign trade volumes are low, so they are suitable to build relatively small targeted dry ports.

2) The centrality analysis of sea ports and central and western inland cities

Doing the centrality analysis needed to be done according to matrix B'. The analysis results are showed in figure 4-5 and figure 4-6.

2-Mode Centrality Measures for ROWS of jieguo2

	Degree	Closeness	Betweenne
Hekou	0.100	0.625	0.000
Pingxiang	0.700	0.833	0.033
Kunming	0.900	0.938	0.063
Nanning	0.200	0.652	0.001
Urumqi	0.700	0.833	0.033
Lanzhou	0.200	0.652	0.001
Xi'an	1.000	1.000	0.094
Zhengzhou	1.000	1.000	0.094
Nanchang	1.000	1.000	0.094
Changsha	0.900	0.938	0.063
Khorgos	0.200	0.652	0.001

Figure 4-5 the centrality analysis result of matrix B' (1)

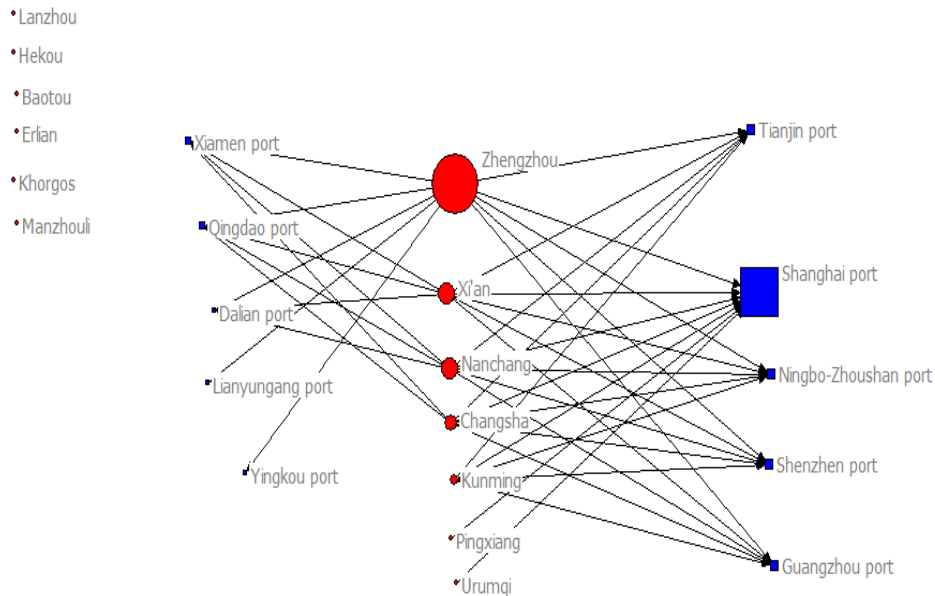


Figure 4-6 the centrality analysis result of matrix B' (2)

According to figures, Zhengzhou, Xi'an and Nanchang exist effective gravity with sea ports, and have more choices when they choose sea port cooperators, should take the same measures as Chaoyang, Yiwu.

Changsha, Kunming, Urumqi, Pingxian are lower in centrality degree, so the choices are limited when they choose sea port cooperators, should take the same measures as Changchun, Shijiazhuang, Shenyang.

Some cities' centrality degree are very small, such as Hekou, Lanzhou, Khorgos.

Since these cities' total foreign trade volumes are low, so they are suitable to build relatively small targeted dry ports.

3) The centrality analysis of sea ports

Conducting binaryzation procedure toward table 4-2, then do the centrality analysis of sea ports. The result is shown in the figure 4-7.

2-Mode Centrality Measures for COLUMNS of jieguo2			
	Degree Closeness Betweenne		
Shanghai port	1.000	1.000	0.258
Shenzhen port	0.909	0.935	0.153
Ningbo-Zhoushan port	0.636	0.784	0.021
Qingdao port	0.636	0.784	0.021
Guangzhou port	0.636	0.784	0.021
Tianjin port	0.636	0.784	0.021
Dalian port	0.455	0.707	0.007
Xiamen port	0.636	0.784	0.021
Yingkou port	0.273	0.644	0.002
Lianyungang port	0.455	0.707	0.007

Figure 4-7 the result of the centrality analysis of sea ports

According to the figure, Shanghai port and Shenzhen port are of high centrality degree, which means both of these two exert more influence to dry ports. So these two ports are priority cooperators for dry ports. Then Dalian port, Yingkou port, Lianyungang port art of lower centrality degrees. These ports exert less influence to dry ports, staying in inferior position when struggling for inland cargo resources.

4) The network density analysis

Doing the network density analysis toward matrix A' and matrix B', then result shows that the network density of matrix A' is 0.6714, and the network density of matrix B' is 0.6273.

5) The core/periphery analysis

a. The core/periphery analysis of east inland cities and sea ports

Since the analysis result could not reflect the gravity of sea ports if matrix A' is set to be the study object, so the study object for the core/periphery analysis is matrix A. The result is showed in figure 4-8.

Starting fitness: 0.155
 Final fitness: 0.236
 Correlation to ideal: 0.236

Blocked Adjacency Matrix

		A1									A2	
		10	7	9	1	3	6	2	8	4	5	
		Lianyungang	Dalian por	Yingkou po	Shanghai p	Ningbo-Zho	Tianjin po	Shenzhen p	Xiamen por	Qingdao po	Guangzhou	
1	Hunchun	0.001	0.007	0.001	0.122	0.017	0.018	0.071	0.011	0.011	0.018	
2	Suifenhe	0.252	1.450	0.173	25.194	3.519	3.633	14.677	2.342	2.302	3.684	
10	Daqing	0.004	0.026	0.003	0.448	0.063	0.065	0.261	0.042	0.041	0.065	
4	Harbin	0.018	0.105	0.013	1.829	0.256	0.264	1.066	0.170	0.167	0.267	
7	Shenyang	0.575	3.316	0.395	57.614	8.048	8.308	33.563	5.356	5.263	8.424	
6	Shijiazhuang	1.354	7.804	0.929	135.604	18.942	19.554	78.996	12.607	12.388	19.828	
9	Shangrao	0.099	0.572	0.068	9.932	1.387	1.432	5.786	0.923	0.907	1.452	
<hr/>												
8	Yiwu	179.701	1035.627	123.340	17996.023	2513.724	2595.018	10483.577	1673.063	1643.993	2631.360	
3	Changchun	1.710	9.853	1.173	171.214	23.916	24.689	99.741	15.918	15.641	25.035	
5	Chaoyang	1794.369	10341.023	1231.584	179695.313	25100.236	25911.979	104681.438	16705.996	16415.727	26274.857	

A3 Figure 4-8 the result of core/periphery analysis A4

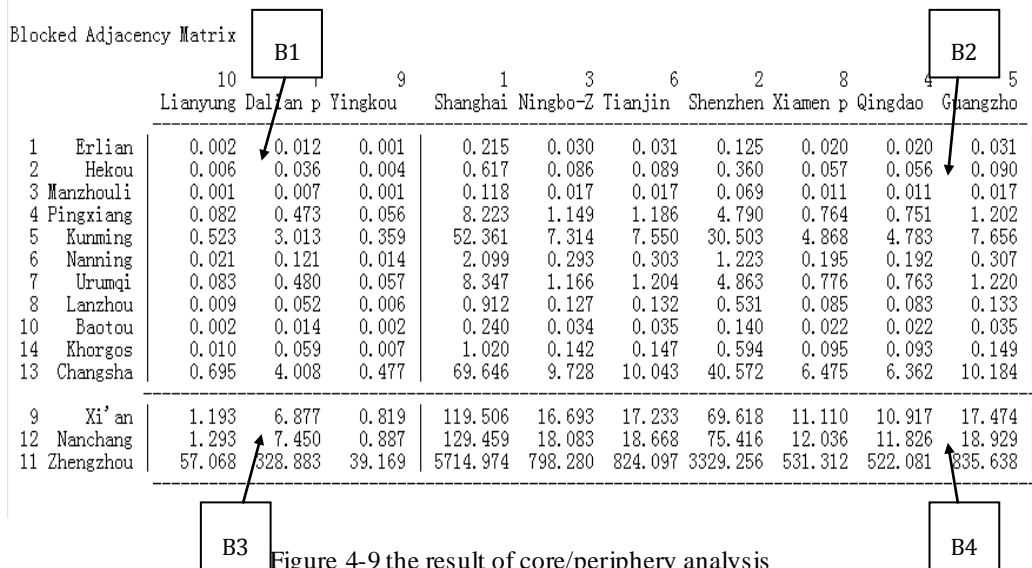
The result of core/periphery analysis separate matrix A into four parts, they are named as matrix A1, matrix A2, matrix A3, matrix A4.

Doing the binaryzation procedure toward matrix A1, matrix A2, matrix A3, matrix A4, the results are named matrix A1', matrix A2', matrix A3', matrix A4'. Doing the network density analysis toward matrix A1', matrix A2', matrix A3', matrix A4', then the results show that their densities are 0.0476, 0.3810, 0.6767, 1 respectively. According to former study, the network density of matrix A' is 0.6714, and it is smaller than the densities of matrix A3' and matrix A4'. The density of matrix A4' is the highest, so it is the core matrix. The core matrix is in accordance with the core network, in this part, the core network is made up by Xi'an, Nanchang, Zhengzhou, Lianyungang port, Dalian port, Yingkou, Shanghai port, Ningbo-Zhoushan port, Tianjin port, Xiameng port, Qindao port, Guanzhou port. Matrix A3' is the subordinate core matrix, the accordance network also play an important role. To be conclusion, Yiwu, Chaoyang, Changchun are priority choices of comprehensive sea ports.

b. The core/periphery analysis of midwest inland cities and sea ports

Doing t the core/periphery analysis toward matrix B, the result is showed in figure 4-9.

Starting fitness: 0.135
 Final fitness: 0.201
 Correlation to ideal: 0.201



The result of core/periphery analysis separate matrix B into four parts, they are named as matrix B1, matrix B2, matrix B3, matrix B4.

Doing the binaryzation procedure toward matrix B1, matrix B2, matrix B3, matrix B4, the results are named matrix B1', matrix B2', matrix B3', matrix B4'. Doing the network density analysis toward matrix B1', matrix B2', matrix B3', matrix B4', then the results show that their densities are 0.2424、0.4545、1、1 respectively. Both of matrix B3', matrix B4' are core matrixes, and the accordance networks are core networks. The core network is made up by Yiwu, Changchun, Chaoyang, Shanghai port, Ningbo-Zhoushan port, Tianjin port, Shenzhen port, Xiameng port, Qindao port, Guanzhou port.

Chapter 5 The linkage development relationship between dry port and sea port

The linkage development relationship between dry port and sea port is a coordination mechanism based on the function of two sides. Besides, it also is the key point to achieve the binding advantages of sea ports and dry ports. Achieving the linkage relationship is a win-win situation, which means to sea ports and dry ports. The linkage relationship has to be built based on scientific self positioning. This part studies the linkage development relationship between dry port and sea port according to the result of chapter four.

5.1 The linkage development models between dry port and sea port

5.1.1 The functions linkage

As the development of modern supply chain, sea ports become one of supply chain's essential points. From the aspect of logistics system, the efficiency of the supply chain which includes sea port not only relays on the operation in sea port, but also depends on the operation of other points. What mention above required sea port consider from the perspective of supply chain when optimizing its logistics system. To achieve high efficient transportation and release conjunction problem, sea port transfer a lot functions to dry port, for example, container staffing, devanning, safekeeping, transit shipment, custom clearance. To become a regional logistics centre, dry port try to build regional logistics network, forming a safe and convenient collecting and distributing system. This can shorten the distance between inland cities and international markets, attracts more cargo resources.

5.1.2 The programming linkage

The construction of dry port is a systematic engineering, which requires the cooperation between many parts which includes government, sea port authority, rail

way authority, shipping company and custom department. Government need to coordinates with sea port to plan the strategic layout of dry ports based on the national economic structure adjustment policy and the economic development strategies in different places. Sea port authority should try to build fast logistics channels with cooperated dry ports when they program the transportation layout in sea port. Rail way authority takes the sailing schedule into consideration when he arranges time schedule for train. Shipping companies can change original sailing schedule to meet the requirement of seamless transportation.

5.1.3 The information linkage

The linkage of information can support the dry port, sea port and custom department with necessary information. Logistics information platform has large amount of data, which includes import/export company information, cargo information, cash flow information, and so on. All of these information can support many government department (such as customs, foreign business management department, industrial and commercial bureau, tax official) to do online custom clearance, online inspection, online export rebate, and other procedures.

Logistics information platform not only help with government departments, but also support dry port, sea port and transportation companies in many aspects. Dry port, sea port and transportation companies use the platform to do online space booking, online transactions, online inquiry, and other businesses. All logistics activities can offer/received better service base on the use of logistics information platform.

5.1.4 The operation linkage

To make the export procedure become more efficient and economic, dry port and sea port should make a joint effort to achieve the cooperation of the customs departments, the inspection departments and rail way authorities in two sides. Inland export companies are able to finish all export relevant activities in inland cities within 24 hours. Government relays on logistics information platform to allocate transportation resources scientifically, meanwhile, the predictive ability of

government can be improved. Sea port relays on logistics information platform to gather cargos in inland cities, releasing sea port from conjunction problem. Shipping company relays on logistics information platform to position cargos, and allocate transport capacity accordingly.

5.2 The analyze and suggestion of the linkage development relationship based on the result of gravity analysis

First, dry port has to make a clear positioning when he develops the linkage relationship with sea port. According to the result of centrality analysis, in the linkage development procedure of sea port and dry port, the role played by dry port is significant, it is not just the economic hinterland of sea port, it also is the important partner of sea port. So, both of inland and costal authorities need to change their original opinion that all things should subordinate to sea ports, and dry ports is a tool to expand market and attract cargo resources. Dry ports is as important as sea ports, they should interact with each to form a points to points network.

Second, dry ports need to be wise when they decide which sea ports to cooperate with, and should make different cooperated policy with different sea ports. Whether a dry port can be attractive to shippers not only depends on the dry port's basic condition, but also relays on the competitiveness of the sea port cooperated with the dry port. Dry ports should refer to the result of centrality analysis when they choose proper sea port cooperators. Inland cities with high centrality degree (Such as Chaoyang, Yiwu, Zhengzhou, Xi'an, Nanchang), exist effective gravity with sea ports, and have more choices when they choose sea port cooperators. In these cities, shippers can choose the cooperated sea ports freely according to the destiny ports, types of goods, sailing routes and sailing schedule in different sea ports. For the inland cities with relative low centrality degree (Such as Changsha, Kunming, Urumqi, Pingxian, Changchun, Shijiazhuang, Shenyang), the choices are limited when they choose sea port cooperators. In these cities, dry port authorities should choose

targeted sea port operators, improving its own competitiveness and attracting more cargos.

Third, under the background of “OBOR”, inland cities need to tack locations, industrial development realities and economic foundations into consideration when they program dry ports, making the dry ports not only meeting the reality, but also lay stress on their own advantages. According to the result of centrality analysis, the positions of inland cities are not the same, not all of them are essential. Only set comprehensive international dry ports in relatively important inland cities, can they maximum the benefit. Of course, it does not means that those inland cities which in subordinate position are unnecessary to set dry ports, on the contrary, these cities need to set targeted dry ports. For example, some boundary cities (Such as Zhangmu, Ruili) are far from sea ports. If they export/ import goods from sea ports, they might cost a lot time and cost in transportation. But they can still take the benefit of their locations, and set dry ports, doing frontier trade and promoting export oriented economy.

Forth, sea ports need to improve attractive force initiatively, diversify cooperated dry ports, and avoid vicious competition. The attractive force of sea ports not only depends on the throughput capacity and the operation efficiency, but also relays on building cooperation relation with proper dry ports initiatively. According to the result of centrality analysis, the dry ports, which located in core logistics network, have good economic foundation and comprehensive transportation facilities, there for they are supposed to be good choices of coordinators. However, the dry ports with good condition would definitely be struggled by many sea ports and stay in relationship with many sea ports. In this situation, the cargo volume will be dispersed. But for some inland cities which have lower centrality degree, their do not have large cargo volume and do not be armed with comprehensive basic facilities, but they are good choose sometimes. The reason is that their cooperators are limited, so the cargo volume is assured, besides, it is easy to keep long term steady relation with these dry ports.

Fifth, as is known to all, resources are limited, so they should be allocated to the area that can maximum the output. Large amount of human, material and financial resources is needed in the procedure of developing linkage relationship between sea ports and dry ports. How to make a good use of these resources is a big problem. According to the result of centrality analysis, “OBOR” area exists two main logistics networks. In the first network, the involved dry ports are Xi’an, Nanchang, Zhengzhou, and the involved sea ports are Lianyungang port, Dalian port, Yingkou, Shanghai port, Ningbo-Zhoushan port, Tianjin port, Xiameng port, Qindao port, Guanzhou port. In the second network, the involved dry ports are Yiwu, Changchun, Chaoyang, and the involved sea ports are Shanghai port, Ningbo-Zhoushan port, Tianjin port, Shenzhen port, Xiameng port, Qindao port, Guanzhou port. Government and sea port authorities should referent to the core logistics network layout when they input resources for dry port construction, assuring the development of core logistics network.

Chapter 6 Conclusions and prospects

6.1 Main conclusions

In this dissertation, a gravity model between dry port and sea port is been established. Then 24 “OBOR” alongside international dry ports and 10 sea ports are selected based on all kinds of sound reasons. According to the gravity model, account the amount of gravity between each dry port and each sea ports. Finally, network analysis method is used to analyze the result of former step, it helps with finding out both core inland cities which are suitable to build comprehensive international dry port and core logistics networks which desire more attention. Furthermore, the dissertation studies different kinds of linkage development modes, then analyze the linkage development relationship between sea port and dry port based on the result of gravity analysis, and targeted suggestions are came up at the end of the dissertation.

Main conclusions are list as follow:

First, within 24 selected dry ports, Chaoyang, Yiwu, Zhengzhou, Xi’an and Nanchang exist effective gravity with sea ports, and have more choices when they choose sea port cooperators. In these cities, shippers can choose the cooperated sea ports freely according to the destiny ports, types of goods, sailing routes and sailing schedule in different sea ports. Undeniably, they are the first choice to built comprehensive international dry port.

Second, within 24 selected dry ports, Changsha, Kunming, Urumqi, Pingxian, Changchun, Shijiazhuang, Shenyang are lower in centrality degree, so the choices are limited when they choose sea port cooperators. For these cities, dry port authorities should choose targeted sea port operators, improving its own competitiveness and attracting more cargos.

Third, according to the result of centrality analysis, “OBOR” area exists two main logistics networks. In the first network, the involved dry ports are Xi’an,

Nanchang, Zhengzhou, and the involved sea ports are Lianyungang port, Dalian port, Yingkou, Shanghai port, Ningbo-Zhoushan port, Tianjin port, Xiameng port, Qindao port, Guanzhou port. In the second network, the involved dry ports are Yiwu, Changchun, Chaoyang, and the involved sea ports are Shanghai port, Ningbo-Zhoushan port, Tianjin port, Shenzhen port, Xiameng port, Qindao port, Guanzhou port.

Forth, the linkage development model between dry port and sea port includes the functions linkage, the programming linkage, the information linkage, the operation linkage.

6.2 The prospects and deficiencies

First, the dissertation studies the network layout based on the result of the gravity model. However, as time goes by, the factors influencing the linkage relationship between dry port and sea port will increase, for example, national policies, foreign destination ports, available sailing routes and sailing schedules. How to quantify these factors and how to reflect these factors in models are questions needed to be studied in the future.

Second, because of some deficient data, the result of gravity model might be influenced.

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