Optimization of Sino-Europe Container Transport Station in the "Silk Road Economic Belt"

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Keywords: Silk Road Economic Belt, Queuing System, Container Transport Station, Sino-European Container Transport

Abstract. Since the rise of the international container transport mode, it has become the main form of international trade. Especially, along with the continuous advance of China's "Silk Road Economic Belt" strategy, at the time of the increase of the land container traffic between China and Europe, there has emerged the issue of how to configure the Sino-European container transport station resources in the "Silk Road Economic Belt", and in this paper, by collating the status quo of the Sino-European container transport station in the "Silk Road Economic Belt", an optimization model of a queuing system based on continuous time batch arrival has been proposed.

1 Introduction

Container yard, also known as container yard, refers to the loading and unloading, transport, storage site in the process of the container transport. As an important part of the container transport system, it plays an important role in the container transport. [1]

The Sino-European Construction and Development Plan (2016 - 2020) (hereinafter referred to as the "plan")" issued by the construction work leading group office to promote the "One Belt One Road has divided the Sino-European hub node (shown in Figure 1-1) into four categories of the inland main source nodes, the main railway hub nodes, important coastal port nodes and land border ports. As these four types of nodes are important places of container handling, transport and storage, therefore, in this paper, the four types of nodes set up in the Plan, as well as other container handling, transport and storage sites influenced by the "Silk Road Economic Belt" strategy and mentioned in the Sino- Europe container transport process are collectively called the Sino-European container transport station in the "Silk Road Economic Belt".

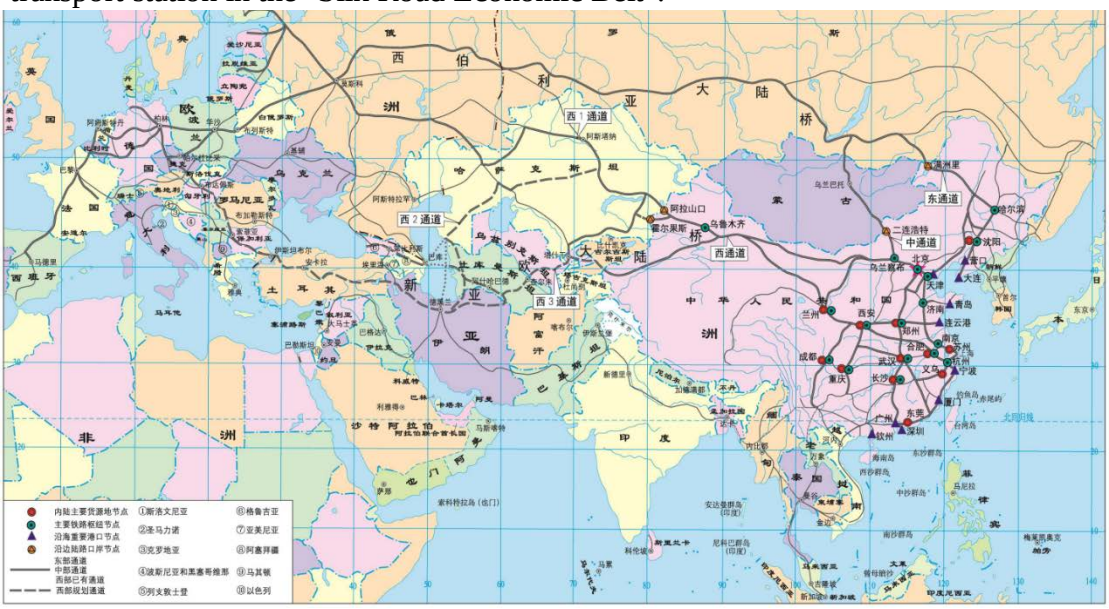

Figure 1-1 Sino-European Hub Node Planning

2 Sino-Europe Block Train Promotes the Surge in Land Container Volume

According to the classification of international trade, all goods in transit can be divided into 56 items, and 32 goods are most suitable for container transport, accounting for 57.7% of the total. Moreover, all these 32 kinds of items are high value-added goods. In recent years, China's railway container has gained huge development and progress, but still has a clear gap from the foreign railway container transport. China's annual railway container volume is only 3 million TEUs, less than 3% of the total freight volume, and a large number of goods suitable for containers are still transported by the railway vehicle. While the containerization rate of miscellaneous cargo transport in developed countries has exceeded 80%, and the proportion of railway container transport accounting for the rail transport of goods has also risen to more than 20%, e.g.: part of the railway companies in the United States y have reached 49%, France is 40%, UK 30%, and Germany is 20%. Due to the advantages of safety and reliability, low prices and highly cost-effective heavy goods by the long-distance transport, there is still a huge potential for development in China's railway container transport.

With the opening of the Sino-European block trains, especially after the proposal of the "Silk Road Economic Belt" strategy in 2013, China's Railway container, especially the railway container transport volume between China and Europe, has an explosive growth, and the growth trend is shown in Figure 2-1. Since the opening of the E Sino-Europe block train, the container volumes for each year have shown in Table 2-1.

Table 2-1 Container volume of the Sino-European block trains

Year	Sino-European Land Container Outward Volume (TEU)	Sino-European Land Container Return Volume (TEU)	Total (TEU)	Container Return Ratio
2011	1394	0	1394	0
2012	3444	0	3444	0
2013	6560	0	6560	0
2014	26070	2296	28366	8.8%
2015	70000	23250	93250	33%
2016	146400	49200	195600	34%

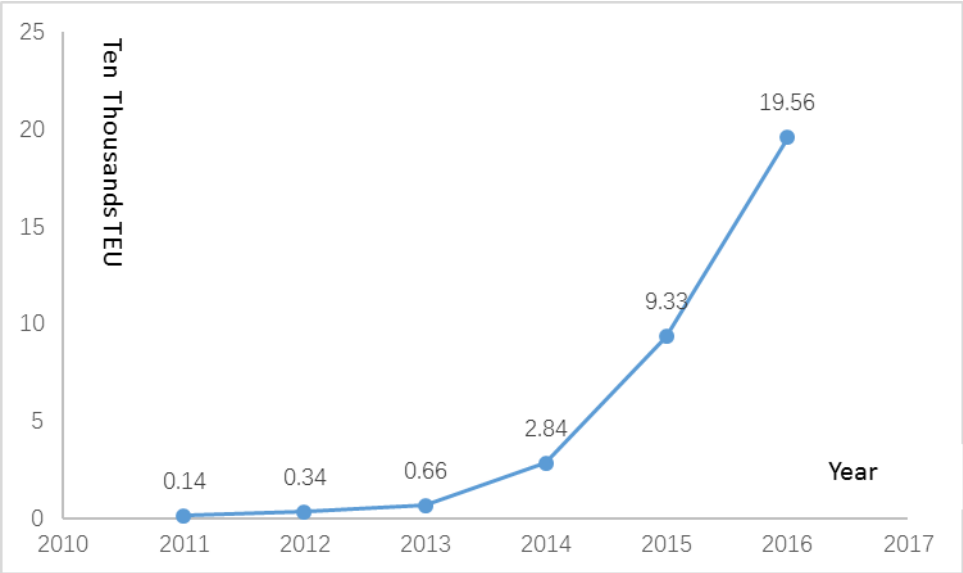

Figure 2-1 Sino-European Land Container Volume Growth Trend Chart

In the strategic background of the China's vigorous promotion of "Silk Road Economic Belt", Sino-European block trains have been competitively opened in all places of China, and

Sino-European land container volume has surged. In Figure 2-2, with the typical representatives of Zhengzhou, Xi'an and Qingdao Container Center Stations of CRINTERMODAL, the land transport container traffic growth trend of the past few years in China has been given a detailed description. In particular, the proposal of China's "Silk Road Economic Belt" strategy has particularly evident impact on the urban container volume in central and western China.

In addition, although the inter-continental container capacity between China and Europe has increased significantly, the Sino-European block trains are still in the early stage of operation, so many local governments have developed a high subsidy policy. For instance, for "Zhengzhou-Europe block trains", goods within 1500 km can be freely transported to Zhengzhou, and then transported to Europe. The price of Zhengzhou-Europe block trains after the subsidy has been equivalent to the price of sea transportation. The price of 'Chongqing - Xinjiang - Europe' provides subsidies directly referring to the price of sea transportation for the notebook business products. 'Chengdu- Europe' provides subsidies referring to the price of sea transportation. 'Wuhan - Xinjiang - Europe' provides fixed subsidies to each standard box, and the government makes subsidies with 60% -70% of the railway freight rates.

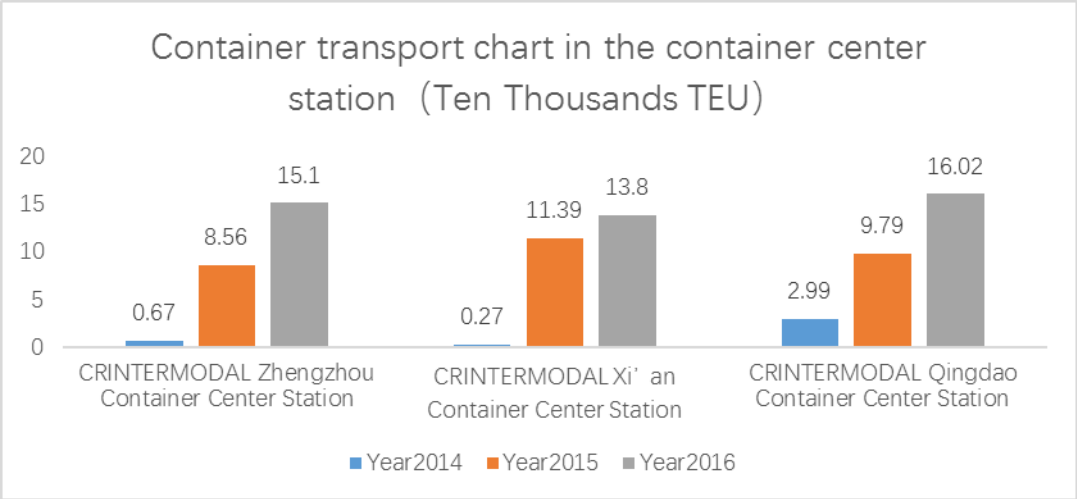

Figure 2-2 Part of the Container Station Traffic Map

3 The Issues faced by the Sino-European Container Transport Station in the "Silk Road Economic Belt"

Container operation process involves multiple operations, and for the entire transport process, it's a key factor in improving the efficiency of the entire transport system of how to make each link in the transport process have the close contact and seamless convergence. [2][3]However, at present, most of the research on container transport stations is focused on the operation level of containers, and few studies are related to other transport links relevant to the station. [4][5][6][7][8]With the proposal of the "Silk Road Economic Belt" strategy, as well as the opening of the Sino-European block trains, the container station of many central and western cities in China have turned from the transport terminals into the transport hubs, and the container traffic has risen sharply. Therefore, the resource allocation for encasement stations in face of the container freight needs in large quantities and diversify is the first issue to be optimized for the Sino-European container transport systems in the "Silk Road Economic Belt".

4 Model Establishment

1. The time interval for customer to arrive A is subject to general distribution, the distribution function is denoted as $A(x)$ and the density function is $a(x)$.

2. Service desk serves the customer in accordance with batch service strategy (a,b) that can

enter in the midway way, the service time of each batch of service B is subject to the exponential distribution of parameter μ: when the customer arrives at the system, and finds that the number of customers served by the service desk is $k(a \le k < b)$, then the customer can directly join the current service process to accept the service; when the customer arrives and finds that the number of customers receiving services in the system is b, and the number of customers in the system waiting area is less than N, the new arriving customers will be added into the buffer zone in the principle of first-come first served, otherwise, when the number of customers in the waiting area is N, the newly arrived customer will not be able to join the system and automatically disappear.

3. When a group of customers have received the service, and if the number of customers waiting for the system is less than a, the service desk is on leave immediately until the end of a vacation, the number of customers in the system waiting area is $n \ge a$. The vacation time V follows the exponential distribution with the parameter θ. When the number of customers in the waiting area $n \ge a$ after a group of customers have received the service or after the vacation, then the service desk immediately provides batch service to the $\min\{n, b\}$ customers in the queue.

4. Due to the limited queuing system space, the maximum customer capacity including those receiving the service is $N + b$.

5. All random processes are independent of each other.

Acknowledgement

This work is supported by “Use of ICT to enable the integration of CSCs” (Grant No.612546), Natural Science Foundation of China (Grant No.71390334), The Fundamental Research Funds for the Central Universities(Grant No. B16JB00230), Major Cultivation Project by Beijing Jiaotong University (Grant No.2015jdzd03).

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