

# Research on Transportation Development of Container Port Starts

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## Abstract

**Under the trend of economic globalization, China's leading position in the world and its dependence on international resources will produce huge transportation demand. This will undoubtedly bring new opportunities for the development of China's container transport industry and provide an important force with sufficient development space. This paper describes the current situation of container transportation in mainland China from the container traffic volume and container port construction in recent years. This paper analyzes the container transportation of main ports in China, and forecasts the throughput of container transportation in China in the future by combining moving average method and exponential smoothing prediction theory. This paper briefly analyzes the impact of the new epidemic situation on port container transportation, and discusses the main factors driving the development of container transportation in China. Finally, it briefly analyzes the role of port container transportation in the development of urban economy, as well as the opportunities and challenges it brings.**

## Keywords

**Container transportation; Port construction; Throughput forecast; Urban development.**

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## 1. Introduction

The world port industry has experienced a change from Western Europe to North America and then to East Asia. Before the mid-1990s, the rapid growth of foreign trade between Japan and the four small dragons in Asia led to the rapid growth of port industry, especially the container throughput. Since then, the world manufacturing base has gradually shifted to China. China has replaced the four little dragons in Asia, becoming the main driving force for the rapid growth of world container throughput, and has further concentrated the world container throughput to East Asia. The rising trend and forecast of container port throughput should be considered and studied.

After the relevant literature retrieval, this paper summarizes the characteristics and trends of container port transportation development. Then, on the basis of the existing data, this paper analyzes the throughput of container ports in recent years to more than ten years. Finally, the interaction between port and city, container port transportation and city is explained.

### 1.1 Background

Port container logistics is the product of the development of global economy, and it is also an important way to promote the world economy and trade. It is not only conducive to the deepening development of the port city, but also of great significance to the integration of the world economy. The integration of the world economy has promoted the rapid development of container transportation. Based on the basic characteristics of large throughput, fast time and large amount of information, container transportation will develop comprehensively and rapidly in the direction of high, fine and sharp. We should gradually improve the comprehensive management level of container transportation, further realize various advanced measures of container and real-time tracking of logistics information

in transportation, avoid the phenomenon of missing and wrong containers in the process of container transportation, which can greatly improve the efficiency, safety and reliability of container transportation.

In recent years, driven by a new round of high-speed growth of foreign trade, the increase of containerization rate and the acceleration of container port construction, China's container market is unprecedentedly prosperous. 80% of the world's goods are transported by ports. Since the reform and opening up, the port has taken the lead in opening up to the outside world, and the shipping industry is the first to realize "going out". Under the situation that the global container transportation center continues to move eastward, China will become the world container transportation center. At present, China's port construction has realized the comparative advantages of the whole industrial chain and all factors, and the technical level is well deserved to be in the forefront, providing logistics fulcrum for international trade.

## 1.2 Development characteristics and trend of container port transportation

Container is a large container with certain specifications and strength, which is specially used for transportation turnover. It is not only a kind of packaging container, but also an effective means of transportation. With its unique advantages, container transportation makes the logistics transportation and loading and unloading link realize fast operation and efficient operation, fundamentally changing the backward appearance of the traditional mode. And it is regarded as a "revolution in the history of transportation". The rise of China's ports makes the world see that in the process of globalization, there is not the concentration of resource elements before the development of ports, but the development of ports ahead of time, and then the concentration of resources. With the rapid development of economy, the volume of international trade is increasing, and maritime transportation, which occupies the main position of international trade, is also developing rapidly. As a modern mode of transportation, container transportation plays a more and more important role in the development of economy and society. Containerization of suitable container cargo is the inevitable trend of the development of goods.

### 1.2.1 Development characteristics of container transportation

Container transportation has entered a relatively mature stage, and its main characteristics are as follows: 1. Container transportation adopts standardized transportation mode; 2. Container transportation is an efficient transportation form; 3. Container transportation is a high-quality transportation form; 4. Container transportation is a transportation form with high investment; 5. Container transportation is a transportation form with high investment A system engineering.

### 1.2.2 Basic development trend of container port

In the face of the development trend of economic globalization, the development and construction of container ports must grasp the historical opportunity of the century, take advantage of the situation and realize the historic leap forward with a new attitude.

1. Digital management of container port: the informatization level and overall management level of modern container port are the basic indexes to measure. Based on the characteristics of large volume, short time, high requirements and large amount of information, container transportation enterprises present the enterprise direction of information intensive. In order to improve the comprehensive management level of container transportation, its development direction should be defined as the form of intelligent container label. Because the characteristic of container transportation is fast, it needs advanced information technology as support. At present, the electronic data exchange technology which is vigorously promoted by China's shipping industry meets this demand.

2. The container transportation system will expand to a higher level, and the position and role of railway in port container collection and distribution system will be improved accordingly. With the development of integrated container transportation, the container sea rail intermodal transportation is extended to a wider range of land bridge transportation, thus forming a global and intercontinental container transportation which combines the sea trunk transportation and the railway land bridge

transportation. In particular, China has a long coastline, numerous ports, a vast hinterland and a long national boundary. The role of railway in the international container multimodal transport will be increasingly improved, and its position in the port container collection and distribution system will change from weak function, less share and obvious advantages to an important mode of port container collection and distribution.

3. Container port construction tends to be large-scale development: with the rapid growth of worldwide container traffic, container port transportation has gradually formed a trend of large-scale development. According to statistics, in recent years, the container load has been increasing, and a new generation of container ships has been put into operation. Many shipping companies have adopted cost strategies to promote the world shipping industry to gradually develop to a large scale. The continuous pursuit of scale economy and the improvement of shipbuilding technology will make the route operation ship type increasingly large. With the large-scale ships, it is required to have a deep-water port with good natural conditions. Therefore, with the expansion of the container terminal scale, the efficient and deep-water terminal has become a necessary condition for the port.

4. The loading rate of the ship will be increased. The loading rate refers to the ratio of the actual carrying capacity of the ship to the rated cargo capacity, which has a great impact on the transportation cost. In general, in the range of rated load, the unit transportation cost will decrease with the increase of loading capacity. The total cost increase from half load to full load is not much, at least the labor cost and maintenance cost in the operation cost are almost unchanged. Although the fuel cost will increase, the fuel cost will not increase in equal proportion due to the influence of the ship's weight. Therefore, to explain with mathematical terms is: the average cost is a function of the loading factor, and decreases with the increase of the loading factor. In order to improve the economic benefit, the ship should be fully loaded as far as possible, the ship should be scientifically stowed, and the hold capacity and load capacity of the ship should be fully utilized to avoid loss of hold.

5. Improving container multimodal transport network is a new direction of transportation development in China. The experience of European and American countries shows that multimodal transport can improve the transportation efficiency by about 30%, reduce the loss of goods by about 10%, reduce the transportation cost by about 20%, and reduce the road traffic congestion by more than 50%. At present, the development of multimodal transport in China is still in its infancy, and the overall development level is not high. We should have a general grasp of the development of multimodal transport and carry out specific measures according to our own development concept. The actual transport nodes in container multimodal transport play an important role in the multimodal transport network. The comprehensive capacity of multi-functional hub plays an important role in the efficiency and capacity of the whole multimodal transport network. We should give full play to the advantages of the multimodal transport network, and choose the transport mode suitable for the region according to the different regional economic development level, economic structure characteristics and natural geographical conditions.

## **2. Research on container port transportation data**

### **2.1 Driving factors of rapid development of port container transportation in China**

#### **2.1.1 The rise of logistics industry**

With the popularity of logistics concept and the extension of logistics practice, customers require more seamless, efficient and convenient logistics services. The development and improvement of logistics is a catalyst for the future development of container transportation in China. The rise of logistics promotes the development of container transportation in China. At present, most of China's container ports have logistics centers relying on ports, and there are more and more phenomena that the port promotes the flow and the flow promotes the port.

### 2.1.2 Policy support from relevant government departments

As an important link to international standards, foreign trade container transportation is particularly important. China's government and competent departments attach importance to and actively plan infrastructure, participate in various conventions promoting container development, formulate and improve relevant policies and regulations, so as to create conditions for container transport enterprises to participate in international competition.

## 2.2 Research on prediction of national container throughput

Due to the novel coronavirus, most of the world is blocked, the economy is in a halt, and the demand for shipping services has dropped sharply. The major shipping companies have launched the most recent halt plan in 2020. The container shipping industry may lose 23 billion US dollars in 2020. Compared with 2019, the container throughput of shipping companies will drop by 10% this year. A well-known analyst said novel coronavirus pneumonia could reduce global container traffic by 17 million TEU this year. Therefore, this paper studies and forecasts the container throughput here. In 2017, China's ports accounted for half of the world's top 20 container throughput, and the national influence of Chinese ports has become more and more significant. According to the "statistical bulletin on the development of transportation industry in 2018", China's ports completed 14.351 billion tons of cargo throughput and 251 million TEU of container throughput in 2018, which increased by 2.4% and 5.3% respectively from the previous year; according to the data of 2019, China's ports have achieved a cargo throughput of 14.351 billion tons and a container throughput of 251 million TEU. It shows that in 2019, China's ports completed 13.951 billion tons of cargo throughput and 261 million TEU of container throughput, an increase of 4.5% year-on-year. Among them, coastal ports completed 230 million TEU, an increase of 4.4%; inland ports completed 30.15 million TEU, an increase of 5.26%. The figure below shows the trend of container port throughput in recent years, so as to show more clearly the development of container port traffic volume.

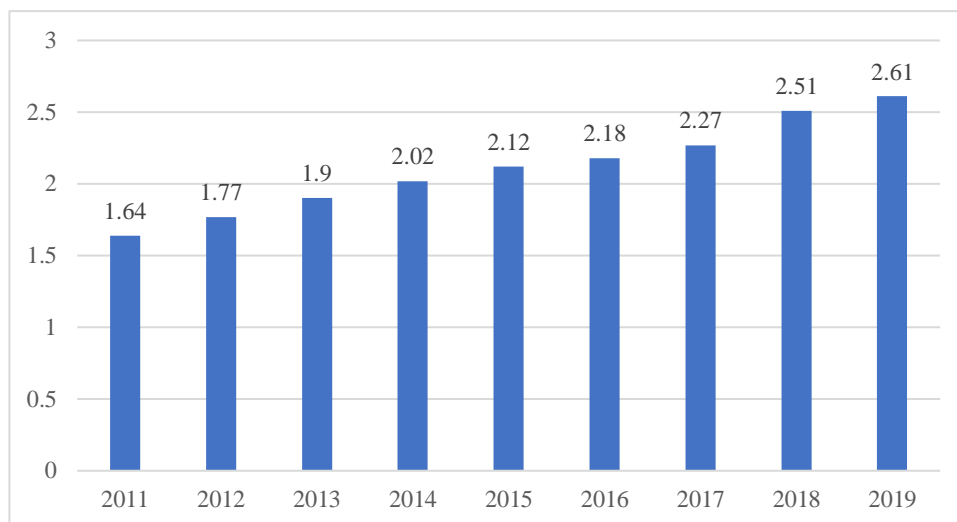


Figure 1 The trend of China's port container throughput from 2011 to 2019

### 2.2.1 Prediction by twice moving average method

(1) First of all, the theory is: let  $y_t$  be the observation value of time  $t$  in the time series,  $n$  is the spanning period of each moving average,  $t = 0, 1, 2, \dots, N$ , the general expression of the moving average with time  $t$  is:

$$Q_t^1 = \frac{y_t + y_{t-1} + \dots + y_{t-n+1}}{n} \quad (1)$$

Similarly, the expression of the quadratic moving average can be obtained:

$$Q_t^2 = \frac{Q_t^1 + Q_{t-1}^1 + \dots + Q_{t-n+1}^1}{n} \quad (2)$$

Establish the model and calculate the parameters of the model:

$$\begin{aligned} a_t &= 2Q_t^1 - Q_t^2 \\ b_t &= \frac{2}{n-1}(Q_t^1 - Q_t^2) \end{aligned} \quad (3)$$

Then, the prediction model of quadratic moving average method is established:

$$Q_{t+T} = a_t + b_t T \quad (4)$$

Calculation process: the second moving average method can be used to predict the total container throughput of China's ports after 1 year, 5 years, 10 years and 15 years. Take  $n = 3$  years, and see the table below after calculating the secondary moving average.

Table 1 average calculation results

Annual	throughput (billion TEU)	$Q_t^1(n=3)$	$Q_t^2(n=3)$
2011	1.64		
2012	1.77		
2013	1.9	1.77	
2014	2.02	1.90	
2015	2.12	2.01	1.89
2016	2.18	2.11	2.01
2017	2.27	2.19	2.10
2018	2.51	2.32	2.21
2019	2.61	2.46	2.32

Then:

$$\begin{aligned} a_t &= 2 \times 2.46 - 2.32 = 2.60 \\ b_t &= 2 \times (2.46 - 2.32) / (3 - 1) = 0.14 \end{aligned}$$

According to the formula:

$$Q_{t+T} = a_t + b_t T$$

The predicted results are:

$$\begin{aligned} Q_1 &= 2.60 + 0.14 \times 1 = 2.74 (\text{billion TEU}) \\ Q_5 &= 2.60 + 0.14 \times 5 = 3.30 (\text{billion TEU}) \\ Q_{10} &= 2.60 + 0.14 \times 10 = 4.00 (\text{billion TEU}) \\ Q_{15} &= 2.60 + 0.14 \times 15 = 4.70 (\text{billion TEU}) \end{aligned}$$

### 2.2.2 Prediction by quadratic exponential smoothing method

(1) The exponential smoothing method is divided into the first exponential smoothing method, the second exponential smoothing method and the third exponential smoothing method. The formula of exponential smoothing method is as follows:

$$Q_t^1 = \alpha y_t + (1 - \alpha)Q_{t-1}^1 \quad (5)$$

The formula of quadratic exponential smoothing method is as follows:

$$Q_t^2 = \alpha Q_t^1 + (1 - \alpha)Q_{t-1}^2 \quad (6)$$

Generally, the value of smoothing constant  $\alpha$  is 0.1 ~ 0.3, and the value is  $\alpha = 0.3$ .

The prediction model is as follows:

$$Q_{t+T} = a_t + b_t T \quad (7)$$

Among them:

$$\begin{aligned} a_t &= 2Q_t^1 - Q_t^2 \\ b_t &= \frac{\alpha}{1 - \alpha} (Q_t^1 - Q_t^2) \end{aligned} \quad (8)$$

(2) Calculation process:

take  $\alpha = 0.3$ , and make  $Q_0^1 = Q_0^2 = y_1 = 1.64$  according to the container throughput data from 2011 to 2019. According to the above formula, the following table data are obtained.

Table 2 Calculation results

Annual	throughput (billion TEU)	$Q_t^1$	$Q_t^2$
0		1.64	1.64
2011	1.64	1.64	1.64
2012	1.77	1.68	1.65
2013	1.9	1.75	1.68
2014	2.02	1.83	1.72
2015	2.12	1.92	1.78
2016	2.18	1.99	1.85
2017	2.27	2.08	1.92
2018	2.51	2.21	2.00
2019	2.61	2.33	2.10

Then the smoothing coefficient is calculated:

$$\begin{aligned} a_{2019} &= 2 \times 2.33 - 2.10 = 2.56 \\ b_{2019} &= 0.3 \times (2.33 - 2.10) / (1 - 0.3) = 0.10 \end{aligned}$$

The prediction model is as follows:

$$Q_{t+T} = a_{2019} + b_{2019} T = 2.56 + 0.10 T$$

The prediction results are as follows:

$$Q_1 = 2.56 + 0.10 \times 1 = 2.66 (\text{billion TEU})$$

$$Q_5 = 2.56 + 0.10 \times 5 = 3.06 (\text{billion TEU})$$

$$Q_{10} = 2.56 + 0.10 \times 10 = 3.56 (\text{billion TEU})$$

$$Q_{15} = 2.56 + 0.10 \times 15 = 4.06 (\text{billion TEU})$$

Through the two methods of container throughput prediction, we can see that the result of the quadratic moving average method is larger than that of the quadratic exponential smoothing method. Due to the serious spread of the epidemic in 2020, it is necessary and very important to systematically understand the current situation of China's port container transportation, actively explore the factors driving its growth, and predict the future development. Container transportation is developing towards the direction of low cost, short cycle and high-quality comprehensive service. Any processing and improvement methods in line with the development law will become the development trend of container transportation.

### 3. Literature References

#### 3.1 Foreign research status

In terms of foreign research, Jonathan boonzaier [1] made a comparative study on the modes of cooperation between ports and shipping companies, such as the alliance and merger between ports and shipping companies, the introduction of shipping companies into ports to participate in terminal business management, and the involvement of ports in inland transportation business of shipping companies. The author points out that the port should redefine itself so as to maintain its important position in the rapidly integrated market environment.

Aidas Vasilis vasiliauskas et al. [2] discussed the changes in transportation system brought by the invention and application of containers in the past few decades, the development of world container fleet and the development trend of world port container traffic volume, and pointed out that the growth of world container transportation is the result of long-term effects of macroeconomic, microeconomic and policy factors.

As for the future development, jakov karmelic, B.Sc. [3] analyzed the throughput of the world's top ten ports, the global container ship fleet and the ranking of these fleet capacity through data, and pointed out that for the current and future situation, it is necessary to analyze the situation of the previous several cycles and its impact on the shipping market in order to prevent more crises.

#### 3.2 Domestic research status

China is the main business growth point and the largest container source of production. At present, container transportation is becoming more and more saturated in industrial developed countries, and is in the ascendant in developing countries. At the beginning of the 21st century, China's container transportation has entered a mature period and domestic container transportation has taken off in an all-round way. Although China's container transportation started late, it has been maintaining a strong momentum of double-digit annual growth in recent years: the status of Hong Kong, Shanghai, Shenzhen, Qingdao and other ports has been continuously improved, making China's container team into the world's top four.

LV Yongbo et al. [4] established an index system for evaluating the competitiveness of container port market 2 through in-depth analysis of various factors affecting container transportation, and provided a fuzzy comprehensive evaluation method including expert weights, and made targeted comparison and Analysis on the evaluation results obtained, and analyzed the influencing factors of container transport port's future development and change The future competitiveness of Hong Kong is evaluated.

Shou Jianmin [5] studied the development process of China's container throughput and its proportion in the world traffic volume, showed us the brilliant achievements of container transportation, and also put forward the Countermeasures for future development.

Chen Changgeng [6] also elaborated the 30-year development of China's port container transportation from not lagging behind to becoming world-class, starting from the positive price comparison relationship between China's port container throughput and the total value of foreign trade import and export, the ranking of China's top ten container throughput ports from 1979 to 2007, and the ranking of the world's top ten ports in 1998-2007.

#### 4. Conclusion

In this paper, the development of container port transportation is simply studied and discussed, and the port container throughput is predicted. The development of port container transportation is an important part of port development. In a sense, the development of port container transportation has become the main symbol to measure the role and status of the port, and also an important indicator to measure economic development. With the development of China's transportation industry, the containerization degree of general cargo transportation is increasing, which makes container transportation occupy an increasingly important position in the transportation system. The stable development of China's container transportation industry is related to China's international economic and trade lifeline as a big export country. In the future, the development of container transportation will be more diversified and more perfect, which can reduce transportation costs, improve the safety and quality of goods, save costs, and promote the rapid development of logistics industry.

In the prediction of container port throughput, the prediction method and model used are relatively simple, and the data may have errors. In addition, the data is not very comprehensive, and the analysis is not very thorough and convincing. In a word, container port construction is a huge and complex systematic project. The higher the comprehensive development level of port is, the more complex the logistics system is. In order to improve the operation efficiency and optimize the transportation system, various feasible measures

should be continuously improved in the development of container ports.

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