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Research on Optimization of Steel Logistics Cost by Railway Containerization

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Abstract: As production technologies and business models continue to innovate, optimising logistics processes has become crucial, especially in logistics-intensive industries such as steel. Transport, storage and management costs remain high and distribution costs are on the rise. Containerisation of railways has become an effective solution to reduce logistics costs by simplifying operations and improving transport efficiency. This paper discusses the current logistics situation in the steel industry and highlights the advantages of railway containerisation in reducing costs, improving efficiency and ensuring the safety of goods transport. The paper also discusses the rapid growth of rail containerisation in China and strategies to optimise steel logistics costs through improved rail infrastructure and intermodal solutions.

Keywords: Railway containerization, Steel logistics, Cost optimization, Multimodal transport , Supply chain management.

1. Introduction

With the continuous strengthening of production technology and mode innovation, more and more people have turned their attention to logistics, which is called the "third profit source", in order to improve efficiency. The iron and steel industry is a logistics-intensive industry, from the transportation of raw materials to the transportation of products, the cost is very large, logistics management occupies a very important position in. Relevant statistics show that in the composition of logistics costs in the steel industry, the proportion of expenditures such as transportation costs, warehousing costs, and management costs is relatively large, and the proportion of distribution costs has a gradual rising trend. How to optimize the logistics process of iron and steel enterprises to reduce costs and enhance the competitiveness of enterprises is an urgent problem to be solved.

2. Current situation of cost composition of logistics management companies in iron and steel enterprises

According to the National Development and Reform Commission "on the organization of the implementation of social logistics statistical accounting and statements" (Development and reform operation document requirements, March 2007 to December 2007, The National Development and Reform Commission, the National Bureau of Statistics and the China Federation of Logistics and

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Purchasing conducted a statistical survey on the status of logistics companies and logistics enterprises in key industries and circulation industries in 2006. There are 142 effective reports of the steel industry in this survey, accounting for 5.4% of the number of effective industrial surveys. In 2006, the sales of steel industry survey enterprises increased by 17, 1% over the previous year, the total logistics costs increased by 15, 5%, and the total logistics costs increased by 1, 6 percentage points lower than the sales growth. The average logistics cost ratio of steel industry surveyed enterprises was 8.77%, which decreased by 0, 12 percentage points compared with 2005.

From the perspective of the composition of management, the proportion of expenditures such as transportation costs, warehousing costs and management costs in the steel industry is still large, but with the modern logistics, the proportion of distribution costs and circulation processing costs in the steel industry has gradually increased. According to the survey data, in 2006, the transportation cost of the steel industry accounted for 62.9% of the total expenditure; Storage costs were 4.5%, an increase of 0, 16 percentage points over the previous year; The administrative cost is 14.3%; Interest expense accounted for 3:83%, which increased rapidly compared with the previous year, with a net increase of 0 and 42 percentage points (see Table 1); Distribution costs and circulation and processing costs were 2, 41% and 2, 26%, respectively, 0, 09 and 0, 04 percentage points higher than the previous year.

Driven by the development of science and technology, in order to improve competitiveness and reduce costs, enterprises continue to innovate and adjust their business models and methods, the application of advanced production methods such as group theory and flexible production has greatly improved the production efficiency of enterprises. The original enterprise is to optimize the internal resources of the enterprise, with the JIT production, agile production, virtual enterprise and global production, the supply chain management, this production mode based on the division of labor and coordination of many enterprises is the supply chain collaborative production, resource optimization beyond the scope of an enterprise. With the deepening of China's economic reform, the country has attracted a large number of foreign enterprises, while more and more domestic enterprises go abroad, China has become an important link in the global industrial chain, supply chain and other advanced concepts are widely accepted and adopted by enterprises, manifested in the global scale of trade, cooperation and increase. As a basic raw material, the circulation mode of steel is related to the cooperation mode of supply chain enterprises, and also affects the cooperation of supply chain enterprises to a certain extent. The development of steel processing and distribution in Europe, the United States, Japan and other countries is developed to adapt to the collaborative production of supply chain. Therefore, the logistics process management of iron and steel enterprises has become the key to enhance the competitiveness of enterprises.[1]

3. Current status of research at home and abroad

With the continuous development of the global economy and trade, the volume of container transport is also increasing year by year, and the container throughput of the world's major national ports is shown in Table 1-

Table 1: Container throughput at ports in major countries of the world (in 10,000 TEUs)

	2012	2013	2014	2015	2016
China	17005	18130	19233	19983	20716
America	4701	4810	5008	5222	5267
Japan	2116	2144	2166	2109	2167
Singapore	3164	3257	3386	3092	3090
Thailand	784	806	866	888	934

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Against this background, research on containerisation to reduce costs in China and abroad has focused on the following areas any studies have focused on the advantages of container transport in reducing logistics costs as a result of traditional transport modes. Wang Ze's study analysed WISCO's raw material terminal as a case study, pointing out that steel container transport improves transport efficiency, reduces cargo damage and cargo loading and unloading time, and in particular, container transport has obvious advantages in railway and sea transport. For example, in railway freight transport, container transport can achieve a variety of intermodal transport, reducing the number of times the goods are moved in the transport process[2].

A study by Cheng Guozheng and Hu Zhimin amines how intermodal transport (e.g., the combination of road, rail, sea and air transport) through containerisation can effectively reduce logistics costs. Intermodal transport can reduce the time and cost of goods in transit and optimise the logistics process. Particularly in international trade, intermodal transport systems have been shown to reduce total[3].

International research on container standardisation is a hotspot, and uniform container specifications and handling procedures have greatly improved logistics efficiency. Domestic research in China has also begun to focus on container standardisation, exploring how to promote the application of container standards on existing railways, highways and other infrastructures in order to further reduce operating costs, as explained in detail in the study by Tineke M. Egyedi [4].

Containerisation is not only dependent on physical standardisation but also on the support of information technology systems. As mentioned in previous studies, the application of information technology in containerised logistics, such as container tracking systems, logistics management software and big data analytics, can further optimise the logistics network and transport routes, reduce empty load rates and waiting times, and thus effectively reduce costs

4. Railway container traffic can continue to grow at a high rate

4.1. Railway freight volume continued to grow rapidly

In 2023, China's railway container delivery volume reached 33.23 million TEU, an increase of 5.1%. Railway containers sent 732 million tons of cargo, an increase of 7.1%. Railway container freight is mainly open top box. In 2023, the railway 35 tons of open top box delivery volume of 474 million tons, an increase of 6.9%, accounting for 64.8% of railway container delivery volume. Figure1 and figure2 shows that China's railway container traffic continues to grow rapidly, and the railway freight volume, the proportion of container cargo increases rapidly too.

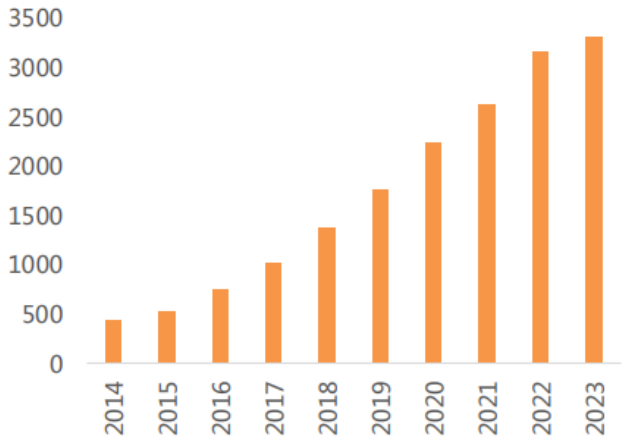

Figure 1: China's railway container traffic continues to grow rapidly

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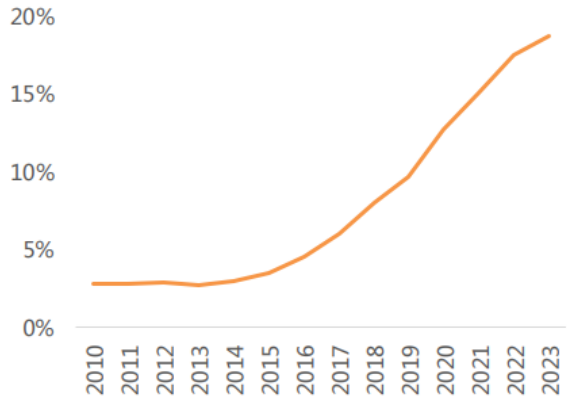

Figure 2: The railway freight volume, the proportion of container cargo increases rapidly

4.2. The combined volume of hot metal continues to grow rapidly

In 2023, the combined volume of container hot metal at ports in China exceeded 11.7 million TEU, an increase of 11.7%. Qingdao Port, Ningbo Zhoushan Port and Tianjin Port led the way with 225,165,1.25 million TEU each. The proportion of hot metal combined transport of port containers continues to rise. Figure 3 shows that the container volume of China's hot metal combined transport continues to grow rapidly

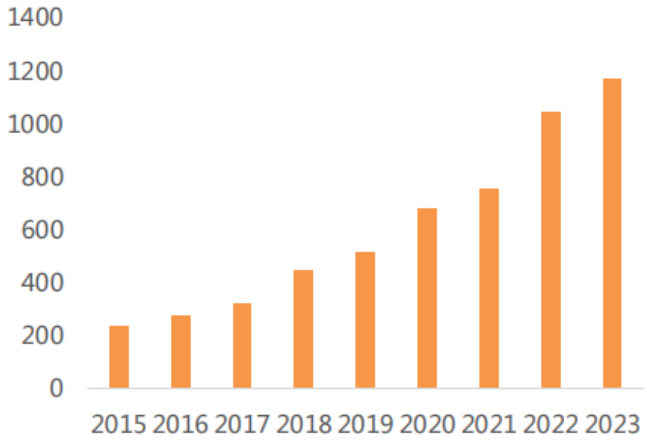

Figure 3: The container volume of China's hot metal combined transport continues to grow rapidly

4.3. The volume of China-Europe freight trains continued to grow rapidly

In 2023, a total of 17,523 China-Europe (Central Asia) freight trains were launched, sending 1.902 million TEU, an increase of 6% and 18%, respectively, and the number of China-Europe freight trains has increased by 47% annually since the 13th Five-Year Plan. In 2023, 4,550 China-Laos cross-border trains will be launched, with a shipping capacity of 173,000 TEU. Shipments reached 4.4 million tons, up 92% year on year. In the 2022-2023 period after the RCEP came into effect, a total of 382 China-Vietnam freight trains will be operated, an increase of 70% compared with the 2020-2021 period before the RCEP came into effect. As we can see figure 4 shows that the number of China-Europe railway services continues to grow.

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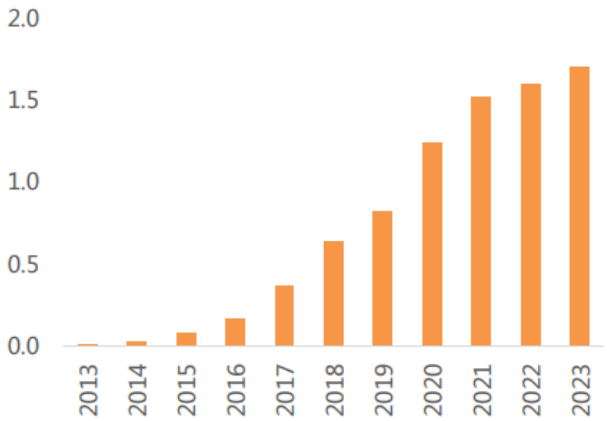

Figure 4: The number of China-Europe railway services continues to grow

4.4. The rise of the West is driving demand for rail transport

In 2010-20, the export of the central region rose and the transport distance became longer, but the advantages of water transport on the Yangtze River inhibited the demand for railway transport containers. Beginning in 2020, the proportion of exports in the northwest and northeast regions will rise, and the demand for rail transportation is expected to increase.

5. Application status of railway containerization in steel logistics

5.1. Advantages of railway containerization

By railway container transportation, the owner only needs to load small goods into the container, pull the car to the freight yard directly to the train, after arriving at the destination, and then unload the container, not only reduce the intermediate secondary loading and unloading operations, reduce the damage rate of the goods, but also greatly improve the turnover time of the goods, saving costs. Therefore, railway container transport is an internationally accepted mode of cargo transport, accounting for more than 75% of the world's cargo transport.

For railways, freight transport is the most important revenue point, accounting for 60% of the total passenger and freight transport. The faster goods are turned around on the railway and the less time they spend in between, the more efficient rail transport is. On the same line, the use of different modes of cargo transport, the benefits can be described as worlds apart. In this way, the development of railway freight technology has a clear direction, that is, containerization, centralization, heavy load, direct and fast. Any of these approaches is a good way to tap the potential of rail freight [5].

Container transportation is a new and advanced modern transportation. It can put a large number of goods into a special container, from the shipper's warehouse directly to the consignee's warehouse, the implementation of "door to door" transportation; Can do door-to-door, home delivery, rail, water transport, road, air transport. This method of transportation is simple, rapid, safe and economical.

Rail container transport refers to the use of international standards or national and sectoral standards for container transport by rail. In order to encourage the use of containers, four priority principles are generally implemented: priority management, priority assembly, priority station entry, priority loading, and are not subject to stop and limit loading. Therefore, container transport goods are sent fast and arrive fast, and are welcomed by customers.

Container transportation has obvious advantages, mainly in:

To ensure the safety of goods - due to the implementation of "door to door" transportation of containers, the goods are packed in the warehouse of the shipper to the consignee's warehouse at the

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arrival station, which has been maintained in the original loading state, the problem of reversing the cargo does not occur halfway, and mechanical operations are used in loading and unloading, which greatly reduces the damage caused by manual handling of goods. Even for fragile items such as glass, the cargo loss rate drops from 25% to less than 8% after the use of containers [6].

Save packaging costs - Because the container implements "door to door" transportation, many goods can be unpacked and loaded into the container in bare or simplified packaging, thereby reducing packaging materials and costs. For example, some goods that were originally packed in wooden cases, after using containers, wooden cases are no longer needed, which not only saves costs but also saves a lot of wood.

Improve loading and unloading efficiency - The loading and unloading of containers are mechanized operations, non-manual handling can be compared, and the efficiency is naturally high. Simplified freight procedures - rail freight transport, each piece of goods need two tickets, and to count each piece. Due to the large number of pieces, writing tickets, tying tickets, receiving goods, or the number of pieces at the time of loading, unloading and delivery are extremely cumbersome, and it is easy to make mistakes. Switch to container transportation, small goods to large boxes, two tickets per box, with lead seal handover, inspection and inventory are very convenient, work efficiency can be increased by dozens of times.

Accelerate capital turnover - Container goods due to the priority of acceptance, priority loading, priority station, priority loading, so the goods transport fast, can supply the market in time, the corresponding capital turnover is fast[7, 8].

5.2. Characteristics of steel logistics

As a bulk cargo, steel has the characteristics of large volume, heavy weight, easy to be damp, easy to corrode and so on. The traditional steel transportation mode mainly adopts bulk cargo transportation or vehicle transportation, which has the problems of low loading and unloading efficiency, high cargo damage rate and high transportation cost. Railway containerization can solve these problems and improve the overall efficiency of steel logistics[9].

5.3. Application status

In recent years, China's railway sector has actively promoted the development of containerized transportation, especially in the transportation of bulk goods such as steel. For example, Hunan region through the opening of "rail and sea transport" steel export container train, the seamless connection of steel from inland to overseas, inland transport costs fell by nearly 60%. This practice fully demonstrates the great potential of railway containerization in optimizing steel logistics costs. Table 2 shows us some example of application.

Table 2: Application status

item	data
Containerized transportation growth	In 2023, 7.9 million TEUs of containers were shipped, a year-on-year increase of 19.8%
Steel transportation costs are reduced	Hunan region "rail and sea combined transport" steel export container train, the inland section of transportation costs fell by nearly 60%
Railway freight volume	From January to June 2024, the national railway shipped 1.92 billion tons of cargo
Multimodal transport development	The number of China-Europe express trains, Rail-sea Express lines and multi-link express trains has increased

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Table 2: (continued).

New box type development and application	Participated in the organization of research and development of 15 new container types, and the number of containers on the road increased to 1 million
Logistics financial service	The total amount of credit financing reached 12.1 billion yuan, and small and micro customers accounted for more than 80%

6. The strategy of railway containerization to optimize the cost of steel logistics

6.1. Increase the number of railway containers and improve transportation capacity

In order to optimize the cost of steel logistics, China should vigorously increase the number of railway containers and improve transportation capacity. By increasing the purchase of containers, expand the scale of railway containers to meet the needs of steel transportation. This can not only improve the efficiency of railway transportation, reduce the time of steel in transit, but also effectively reduce the loss of goods and reduce logistics costs. At the same time, increasing the number of railway containers will help ease the pressure on railway transportation in China and provide more stable and efficient transportation services for steel enterprises[10].

6.2. Improve railway transport lines and reduce transport costs

Optimizing railway transport lines is the key to reducing steel logistics costs. China should increase the investment in railway infrastructure, improve the layout of railway network, and improve the coverage and transportation efficiency of railway transportation lines. Through reasonable planning of transportation routes, reduce the transfer links in steel transportation and reduce transportation costs. In addition, strengthen the maintenance and management of railway lines, ensure transportation safety, and further improve the timeliness and reliability of steel logistics.

6.3. Improve the level of information and improve transportation efficiency

In order to improve the efficiency of steel transportation, China's railway logistics enterprises should improve the level of information. By establishing a perfect logistics information platform, the real-time sharing of steel transportation information can be realized and the accuracy of transportation plan can be improved. At the same time, big data, the Internet of Things and other technical means are used to monitor the steel transportation process in real time, optimize the allocation of transportation resources, and reduce transportation costs. Improving the level of informatization will help improve the overall operational efficiency of railway steel logistics and create more value for enterprises.

6.4. Innovate the logistics model and improve the level of steel logistics service

In order to meet the market demand, China's railway steel logistics enterprises should constantly innovate the logistics model. Through the promotion of multimodal transport, joint distribution and other new logistics models, improve the service level of steel logistics. At the same time, strengthen cooperation with steel production, sales and other enterprises to provide customized, integrated logistics solutions. Innovative logistics mode helps to enhance the competitiveness of railway steel logistics, reduce costs for enterprises, improve efficiency, and achieve win-win development.

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7. Conclusion

In conclusion, railway containerisation has proved to be an effective way to reduce costs, improve efficiency and enhance the comprehensive competitiveness of steel enterprises in steel logistics. The use of containerised transport by steel enterprises can shorten the transport time, reduce the cost of loading and unloading and warehousing, and improve the safety of the transport process. Multimodal transport combining road, rail and sea transport further optimises logistics, shortens transport time and maximises the efficiency of transport resources.

In order to fully optimise steel logistics costs, there is a need to continuously increase the number of rail containers, improve rail infrastructure and make use of advanced information technologies such as big data and the Internet of Things. These measures will improve the operational efficiency of the logistics process and ensure that steel companies maintain a competitive edge in an increasingly globalised market.

In conclusion, rail containerisation is a key strategy for the future of steel logistics, as it offers a sustainable and cost-effective solution to the challenges of transporting bulk goods. By continuing to invest in infrastructure and innovation, China's steel industry can achieve greater logistical efficiency and remain competitive on the world stage.

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