

# Risk Control of Key Links in International Transportation of Bulky Cargo

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**Abstract:** In recent years, China's global cooperation in the field of infrastructure has been deepening. Concurrently, the demand for international transportation of super-large and super-heavy machinery and equipment has increased dramatically. This phenomenon not only drives the development of the global economy, but also promotes the development of the international transportation of bulky cargoes. As the cargoes in question are of a considerable length, weight and dimensions, and are typically required for the construction of major national engineering projects, the international transportation of such cargoes is characterised by a high cost, high requirements and high risks. Currently, our country is still in the nascent stages of developing effective risk control measures for the international transportation of bulky cargoes. Identifying and responding to the risks associated with this type of transportation has become a pressing concern. Consequently, the enhancement of research on the comprehensive transportation scheme of bulky cargoes, particularly the examination and management of transportation risks in pivotal junctures, will facilitate the enhancement of the quality and efficacy of China's international transportation of bulky cargoes and serve as a constructive contribution to the sustainable advancement of the bulky logistics and transportation industry.

**Keywords:** Bulk Logistics, International Transportation, Risk Control

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## 1. Introduction

Risk management in logistics is becoming a strategically important managementsubsystem of a modern organization (Kubasova, 2018; Cervantes-Cabrera, 2018). In general, the value of large goods is high, the degree of precision is also high, and it is not easy to decompose and disassemble. Therefore, the transportation process must consider the impact of various factors. In order to ensure safe and efficient transportation while reducing transportation costs, it is essential to grasp the key aspects of the risk points. This paper analyzes the risk of the key aspects of large logistics transportation programs and proposes solutions to current problems. The objective is to enhance the effectiveness of logistics planning and facilitate the growth of the international transport industry for large logistics.

## 2. The Characteristics of International Transportation of Bulky Cargo

The weight, volume, value, and other characteristics of large cargo and general cargo differ significantly. Bulky cargo, in particular, is often of ultra-high value, super-complex, and carries an elevated risk of damage or loss. To ensure the safety of the transportation process, large logistics and transportation enterprises should carefully plan and execute each link of the transportation process, from the initial loading to the final delivery. This planning should consider potential risks and contingencies to avoid the occurrence of major accidents that could result in significant economic losses.

### 2.1. High-cost

The transportation of bulky cargoes often necessitates a significant investment of capital. Before transportation, it is essential to invest a considerable sum in the acquisition of specialized transport vehicles, the training of professional drivers, the securing and reinforcement of cargoes, and other related expenses, which collectively contribute to the elevated cost of transporting bulky cargoes. In transportation, bulky cargo transportation needs to cross several regions, and the conditions of transportation between different regions are very different, so it is necessary to take multimodal transportation, which also makes the transportation cost of bulky cargo higher than the general cargo. After transportation, the bulky goods may result in damage to roads and vehicles along the route, necessitating additional investment in infrastructure development. Consequently, the overall investment in transportation costs is increased.

## **2.2. High-requirements**

The transportation of bulky cargoes often presents significant operational challenges and specialised transportation requirements. Before transportation, it is necessary to conduct a comprehensive survey of the transportation route, the surrounding environment, the highway along the route, the loading and unloading terminals, which increases the difficulty of the pre-transportation preparation work. In transportation, the operating personnel must undergo professional training to ensure the accuracy of operation in each link and key step, and the followers also have profound professional knowledge and the ability to cope with emergencies. After transportation, it is important to ensure that the surrounding area is flat and compacted to meet the conditions required for unloading and storage of oversized cargo. This additional step increases the difficulty of the transportation process.

## **2.3. High-risk**

The transportation of bulky cargoes is accompanied by a multitude of complex and high-risk situations. Before transportation, it is imperative to select a scientific and reasonable transportation mode and a reliable transportation service provider, as these factors directly influence the safety risk of transportation and the risk of the project schedule. In transportation, bulky cargoes are frequently constrained by the conditions of roads, bridges, and tunnels, which can result in the catastrophic consequences of vehicle destruction and ship sinking in the event of accidents. After transportation, it is essential to ensure that it reaches its destination in a timely manner and is safely unloaded. Given the inherent unpredictability of any transportation process, the risk of international transportation of bulky cargoes is inevitably heightened.

# **3. Key Links in International Transportation of Bulk Cargo**

In the process of international transportation of bulky cargoes, it is necessary to take practical measures in the key links of the transportation of bulky cargoes in order to be able to complete the highest requirements of the transport task with minimum risk and minimum cost. These measures include, but are not limited to, multimodal transport programs, lifting methods, and reinforcement of the bundling and selection transportation.

## **3.1. Multimodal Transportation Program**

The transportation of bulky cargoes across national borders necessitates consideration of the disparate environmental conditions of the transportation routes in each country. Additionally, the varying requirements of different transportation modes for different sections of the road must be taken into account. Each transportation mode possesses its own advantages. Consequently, when devising an international transportation plan for bulky cargoes, it is essential to consider not only the specific requirements of customers but also the unique attributes of the cargo and the specific road conditions of each country along the route. A multimodal transportation program entails the adoption of multimodal transportation and the subsequent design of an optimal path planning plan, taking into account the three major elements of transportation time, transportation cost, and transportation routes.

## **3.2. Lifting Program**

The transportation of bulky cargo is a crucial aspect of logistics, with the choice of lifting point, lifting method, and operator control all playing a significant role in ensuring the safety and efficiency of the process. It is typical for the international transportation of bulky cargoes to be conducted in conjunction with both land and sea transport, particularly in port operations. In such instances, it is advisable to utilise the loading and unloading efficiency of machinery and equipment for lifting, and to make full use of lifting equipment to avoid the unnecessary duplication of labour, which would otherwise result in increased transportation costs. There are six common lifting methods employed in bulky cargo transportation: tower crane lifting, bridge crane lifting, car crane lifting, crawler crane lifting, hydraulic lifting method, and pontoon boat lifting. Regardless of the specific lifting method employed, the selection of the lifting program should be based on the principle of ensuring the highest stability and the largest safety factor, in accordance with the actual situation of lifting, in order to protect the goods from damage during the lifting process.

### **3.3. Reinforcement and Bundling**

The reinforcement and bundling of bulky cargo is an indispensable aspect of its transportation. However, due to the unique characteristics of bulky cargo, including its irregular shape, uneven center of gravity, and other factors, it is susceptible to the development of local stresses. In the crucial phase of reinforcement and bundling, it is of paramount importance that the operator adheres to the fundamental principles of reinforcement and is well-versed in the essential aspects of bundling. This entails the utilisation of steel wire rope, chain, or 3-5 tons of gourd and other requisite tools for bundling and reinforcement, or alternatively, through the application of welding and other related processes. To affix the bulky cargoes on the board of the car or ship, and then through the scientific method of data verification to ensure that the bulky cargoes will not be displaced and that the cargo will not suffer damage during transportation. The objective is to guarantee that the bulky cargo will not be displaced or damaged during transportation.

#### *3.3.1. Bundled Principle*

It is imperative that bulky cargo be securely tied down on the transport vehicle to prevent any displacement of the load on the vehicle. Rubber plates should be placed between the bulky cargo and the transportation vehicle to increase the friction coefficient between the cargo and the facility and prevent the cargoes from sliding on the transportation vehicle during transportation. In order to prevent damage to the cargo or package, it is necessary to use steel wire rope to cover the rubber tube. The tying up should be carried out in eights or around the bundle in order to ensure the safety and effectiveness of the process.

#### *3.3.2. Bundle Points*

In the key aspect of reinforcement and strapping, the strapping must be secure and must ensure that at no time is the cargo displaced in any way on the transport vehicle. First, rubber sheets should be placed to increase the coefficient of friction between the cargo and the facility to prevent the cargo from sliding on the transport vehicle during transportation. Secondly, tools such as steel wire ropes and cables, chains, or hoists with a capacity of 3-5 tons are employed to implement eight-way lashing or round-bundle lashing in order to reinforce the lashing. In order to conserve tying ropes and enhance the tying effect, the steel wire rope should not be bent at a significant angle, and the tying angle should be maintained at 30°-60° (Wang,2020). Finally, in order for the large cargo to remain stationary on the plane plate, the friction force must be equal to or greater than the inertia force. Conversely, when the bulky cargo is located in the inclined plate, the lateral friction resistance of the equipment on the plate must be greater than the centrifugal force plus the side sliding force(Li Feng, 2019).

### **3.4. Selection of Means of Transportation**

The transportation of bulky cargoes should be carried out by means of suitable means of transportation chosen in accordance with the characteristics of the cargo and the conditions of the transportation route. The common equipment used for the transportation of bulky cargoes is mainly divided into two parts: land bulky transportation equipment and sea bulky transportation equipment. When choosing a reasonable means of transportation, it is necessary to consider not only economy and safety, but also the convenience of loading and unloading of the means of transportation.

The land transportation means of large cargoes typically encompass trucks, flatbed trailers, tractor-trailers, railroad wagons, and other similar vehicles. Prior to selecting an appropriate land transportation means, it is essential to identify a suitable vehicle based on the weight and dimensions of the goods, the distance to be traveled, the carrying capacity of the roads, bridges, and tunnels, and other pertinent constraints.

The maritime transportation of bulky cargoes typically employs towing and self-propelled ship transportation. Towing is utilized to provide the requisite power to the mode of transportation, which may include deck barges, among other vessels. The self-propelled ship itself possesses the capacity for sea navigation, encompassing heavy lift ships and other similar vessels. Prior to selecting an appropriate mode of maritime transportation, it is essential to select a suitable vessel according to the weight and dimensions of the cargo, the distance to be traversed, the capacity of the pier, and the stability of the ship, among other considerations.

## 4. Conclusions

The increase in investment by major international companies in China and large state-owned enterprises in overseas investment projects has led to a growing interest in and preference for “Made in China,” “China Infrastructure,” and other brands around the world. In the coming years, materials supply risks associated with the energy transition and geopolitics are likely to intensify and new risks are expected to emerge.(Ku A Y,2024) In parallel with this, the international transportation of Chinese bulky cargoes is receiving increasing attention from the public, due to the characteristics of bulky cargoes with a large volume, high value and high risk. This makes the international transportation of bulky cargoes a complex and systematic process, and any negligence in some key links will not only damage the cargoes themselves and cause significant economic losses, but also affect the process of international engineering projects. In order to ensure the safe delivery of large cargo to the destination, it is essential that the key links in the transportation process implement reasonable and feasible control measures. In the near future, logistics and transportation enterprises must comprehend the present state of development, research and development of new technologies, a more profound examination of large cargo in international transportation, risk identification and countermeasures, in order to fulfill the demands of the advancement of international transportation of large logistics, thus enabling the advancement of China’s logistics to become increasingly robust, and to facilitate the creation of world-class international logistics enterprises.

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