Research on Container Big Data Application

Shibo Xu¹, Jing Wang*, Jichun Li², Wensheng Cao³
China waterborne transport research institute, Beijing, China
¹xushibo@wti.ac.cn, ²wangjing@wti.ac.cn, ³Ljc217@wti.ac.cn, ³cws@wti.ac.cn

Abstract—The container transport is the most important equipment of global supply chain, which connects economy of most countries in the world. A huge amount of data will be generated during container transportation. In this paper, the current transportation risks and problems in container transportation are presented in detail, and the construction plan of the container big data platform is proposed, including how to obtain data, what types of data are obtained and how the big data platform optimizes the existing transportation safety and efficiency, and finally specific recommendations are put forward to better promote the construction of container big data platform.

1. Introduction
The container as the most important equipment of global supply chain is changing the people’s life, which accelerates step of social development. However, development of container is not smooth sailing, but is long and hard process from starting phase to current mature phase. The biggest success of container transport is building the container transport standard and corresponding transport standard system, and this standardization concept creates great miracle of human history, the number of containers is getting more and more. There are about 230 thousand in 1970, about 2,080 thousand in 1983. Up to now, the number of containers is soaring to about 40,000 thousand. Among them, general containers (including non-pressure dry bulk containers) account for about 75%, refrigerated containers account for about 8%~12%, tank containers account for about 5%~8%, and the rest of the containerized products (including rack containers, exchange containers, high special containers, non-standard containers, etc.). In recent years, with the development of cold chain transportation and chemical transportation, refrigerated containers and tank containers have grown rapidly, and the total proportion of the two has reached 20%. Non-standard containers such as highway special containers have gradually declined, and have been less than 2%. Needless to say, container transportation has become the most important mode of transportation.

At the same time, Container transportation also has entered the stage of multimodal transportation and "door-to-door" transportation. The realization of combined multiple modes of transportation makes container transport occupy an absolute advantage, more and more cargoes choose to use container to transport. In the process of container transportation, a huge amount of relevant data is generated, how to use these data well has become a widespread concern, and people have realized that these data can generate huge value.

2. What are the current problems of container transport
Although the advantages of container transportation are already obvious, with the rapid development of science and technology, such as Big data, 5G, IOT (internet of things), cloud computing and other
advanced technology, the advantage of using container will become more and more outstanding. People's requirements for a better life have also become higher and higher. They hope that container transportation can become a perfect carrier to reduce costs, improve efficiency, and increase safety. Compared with advantage of current container transportation, some current problems and risks of container transportation that need to be solved.

2.1 *Using container transport to stowaway and smuggling problem*

Since the container is sealed, when the container is closed, what is loaded in it and what happened in it are unknowable. There have been many cases of stowaway through containers, On October 23, 2019, Essex police found 39 bodies in the container. The victims included 31 men and 8 women. This incident once shocked the entire international community. This reminded many people of the Dover Port incident in the 2000 year in the UK. 60 people were smuggled into the UK through truck containers, resulting in the tragic death of 58 people. There are more than one case of smuggling with containers, and many are still undetected.

At the same time, the use of containers to smuggle drugs and other contraband is also common, for example, In May 2020, the China Customs Anti-smuggling Bureau found a suspicious clue through daily risk analysis. Imported goods were declared as "frozen pig ears", and the declaration of imports was carried out in a "one vote and one cabinet" manner, through hard inspection, 40 kg of drugs were seized in the Maersk container in Yantian Port.

Italian police recently intercepted three highly suspicious containers at the port of Salerno, 32 miles south of Naples, the southern port city. After careful inspection, they found that there were as many as 84 million tablets of amphetamines with a total weight of more than 14 tons in a container. The police initially estimated that the total value of the drugs involved could be as high as $1.1 billion. Thus, we can find container may be equipment of stowaway and smuggling.

2.2 *Cargo in container damage and lost problem*

Huge loss happens due to loss and damage of goods every year. For example, at the end of January 2008, the occurrence of pesticide poisoning caused by the consumption of dumplings in Japan also caused widespread concern in the international community. Many experts analyzed that the real possibility of dumpling poisoning is very likely to appear in the long transportation and storage process. But this view is hard to be proved by evidence.

In December 2011, 1,680 Apple mobile phones were loaded into containers in Shanghai and left the port, but the phones disappeared when they arrived in the United States.

Another events such as a container arrived in the Netherlands. After the goods arrived in the Dutch port, the customer actually said that there were more than 100 boxes missing in the cabinet, but the intermediate customs did not check the goods, and the seals had not been moved after arriving at the port. The factory counted the quantity correctly. No body know what happened and why the boxes missed. Cargo lost has become the biggest issue that troubles the cargo owner.

2.3 *Potential weapon safety problem*

In 2010, the advent of the Russian "Club-K" container cruise missile caused a sensation worldwide. This container cruise missile improves its weapons and vehicles to make it closer to the actual combat needs and the battlefield environment, and its deterrent power is significantly improved. As a powerful weapon with a brand-new concept, it is loaded with cruise missiles in the form of containers. Its appearance is no different from that of ordinary container containers. It can be concealed in logistics and enhances the suddenness of missile attacks. Secondly, its combat command and logistical support modules are integrated into the container, so that the anti-missile system is invincible, so that real-time combat can be achieved.
2.4 Container transport information invisible problem
Because the information of container is often segmented and held in the hands of different logistics participants, the logistics information is relatively scattered. It is difficult for one of them to share the entire logistics information of the container that caused many information isolated islands and information blind spots, and the shipper and buyer often do not know real situation of their own goods. It is often the case that the agency company tells the shipper that the container has been shipped on board, but it is still in the yard. Due to the lack of big data support, the opaqueness of this information seriously affects the efficiency and security of container logistics.

2.5 Cargo source and container matching problem
Due to the imbalance of trade, opaque container information, and lack of data support, a large number of containers with unloaded goods are transported from regions with abundant supplies to regions with scarce container sources every day, resulting in a large number of empty container transfer problems. Take the United States as an example. There is one empty container for every five containers transported by sea. In Asia, 16% of the containers passing through Japanese ports are empty. According to Drewry estimates, the direct and indirect losses caused by the imbalance of empty containers in the region reached US$10.5 billion. In the past few years, costs growth of most carriers’ operating has greatly exceeded the growth of revenue, resulting in a lot of waste of empty container resources. There may be a large number of empty containers near the source of the supply. Due to lack of data support, these sources often need to transport empty containers from far away, cause serious waste.

2.6 Low utilization of container data problem
The current container data contains many various parameters of the logistics supply chain. These parameters are the key indicators for measuring the level of logistics development and efficiency. Through these objective data, they could have truly reflected the social commercial trade situation, industrial distribution situation, and bottleneck problems of restricting economy development.

At same time, through analysis of container big data, which also could have told you which container has safety risk, and where the nearest empty container is, and helped the senders realize the most reasonable matching and saved transportation costs, etc. However, due to the problems of data incompleteness and information isolated islands, the container data can hardly be fully utilized, data cannot be effectively mined, making it difficult to generate valuable information.

Therefore, the construction of container big data platforms has become the future development trend.

3. Container Big data platform construction
In order to deal with the above problems and risks, container big data platform is becoming urgent. Container big data platform need to clarify the following key factors: how to obtain the container data, what kind of container data will be restored in the big data platform and what is the function of the big data platform.

3.1 How to obtain the container data for big data platform
There are two important ways to obtain the container data: the first way is that the participants related to container transport could provide their own container data to big data platform. The second way is that collecting the container data by sensors fixed on key nodes and container automatically.

- participants are the shippers, ocean carriers, terminal operators, 3PL providers, inland transportation providers, government authorities, and other supply chain stakeholders who may provide and/or exchange information with the big data platform. These roles define what data he can provide to the big data platform.
Figure 1. Related participants of container transport

Container intermodal transport operators can be classified into transport operators and transport auxiliary operators according to the service object and nature, as shown in figure 1. In order to obtain these container data, the big data platform will provide the processed information to these participants for encouraging them provide actively without prejudice to the interests of third parties.

- Smart sensors will provide the container data to the big data platform, some sensors usually are fixed in some important transport nodes such as port gate, yard, warehouse and some are fixed on the handling machineries. When containers pass through these transport nodes with sensors, the container information will be transmitted to the big data platform. Now more and more containers are equipped with automatic monitoring devices, these monitoring devices can provide all real-time transport information to platform, such as container temperature information, container location information, the safety status information and other sensor information. With the rapid development of IOT(internet of things) technology, which will help container big data platform obtain more and more real data without the need for participants to manually send data.

3.2 What types of container data will be restored in big data platform

The key types of container data contain: admin event, planned event, estimated event, actual event, other event, trade document and sensor data. These definition as shown in table 1.

| Data type  | Definition                                                                                                                                 |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Admin Event| An instructional request by an authorized party to set up, establish relationships, grant authorizations, and other administrative activities for a shipment, consignment, or transport equipment. |
| planned event| The planned events to be carried out to deliver the transport service and often align with pro-forma schedules. The Transport Service Provider is responsible |
| Data type | Definition |
|-----------|------------|
| for the plan and is the only party allowed to issue and change Planned Events. |
| estimated event | Estimates of events about to happen related to a specific transport equipment. Any participant involved in executing a transport plan can issue Estimated Events related to its role in the transport. |
| actual event | Occurrences of events that have been carried out and relate to a specific transport equipment. Any participant involved in executing a transport plan can issue Actual Events. |
| other event | Other transport and logistics events such as document-related events, customs-related events, and IoT data. Document-related events communicate an action (e.g., document submitted) on a specific document. |
| trade document | Documents, such as a bill of lading, which can be maintained in structured or unstructured form. |
| sensor data | Sensor data, such as temperature, humidity, safety status, location, time, alarm, RFID etc. |

3.3 What is the function of the container big data platform

The construction of the container big data platform will be able to fundamentally solve the problems and risks mentioned above that can be optimized in the following aspects:

- The container big data platform can improve the identification of smuggling and smuggling issues. Through big data, it can be discovered which containers may have smuggling and smuggling issues. As mentioned above, in May 2020, the China Shenzhen Customs Anti-smuggling Bureau successfully seized drugs. In the smuggling case, the discovery of drugs was attributed to the existence of big data. The data shows that the container was transferred from South America to Europe and then to Asia, but South America is not the main source of frozen products imported from China, which is not in line with common cognition. It reminded China's anti-smuggling department to immediately list the consignment as a key target, carried out in-depth risk analysis and judgment, and controlled the container, thus successfully cracked this drug smuggling case.

- The container big data platform can trace the incidents that occurred during transportation, such as the poison dumpling incident mentioned above. If there is container big data at that time, you can know what nodes the dumplings have experienced from the factory to the destination. Whether the dumpling was checked at these key nodes, and whether the poisoning event caused by environmental changes such as temperature and humidity during the process of transportation. Finally finding out the real reason, avoiding injustice for some related enterprises or individuals.

- The container big data platform can identify which container may have risk to be camouflaged to weapons by analyzing where it has been, what goods it has packed and other information in big data platform.
• The container big data platform can make container transportation more transparent, and all the participants in the logistics supply chain can easily know the location and status of the container, which can greatly improve the efficiency and safety of container transportation, and reduce the transport cost of goods in transit. At the same time, it can allow upstream and downstream enterprises to timely obtain the location and status information of containers or goods, which is convenient for enterprises to arrange production and dispatch in an orderly and reasonable manner, and reduce enterprise costs.

• The container big data platform can solve the problem of container matching at the greatest extent. The big data platform can tell the companies that need to use containers, which empty containers can be used around them, reducing the problem of remote provision of empty containers, thereby reducing logistics transportation costs. In addition, the solution of the matching of containers and cargoes can also better promote the rapid development of the industry, make the location of the factory more economical and reasonable without considering container transport too much, and improve the competitiveness.

• The container big data platform can also generate a lot of derivative value. Through these objective data, it can truly reflect the container trade situation, industrial distribution situation, and transportation security situation of different countries, and can provide data support for national industrial economic policies.

4. Conclusion
In order to promote development of container big data platform well, the following conclusion and suggestions are feasible:

• The platform should adopt blockchain technology. Because blockchain technology uses distributed accounting and key consensus technology, it has the advantages of information anti-tampering and data traceability, which encourages participants in the container supply chain to provide their own data to the platform, and at the same time obtain the data within the scope of their authority from the platform, thus ensuring the big data platform to obtain enough container data.

• Every country should encourage companies to fix more and more sensors at the key nodes of logistics supply chain to collect the container information automatically, which contribute to collect enough real container information without artificial processing.

• A new generation of integrated intelligent containers should be encouraged to produce, this kind of container has its own sensors without retrofitting, which can transfer its real-time location information, temperature/humidity information, safety status information and other sensor data to big data platform.

• International cooperation should be strengthened between different countries. Because container information is difficult to be obtained by only one or a few countries, different countries have their own desires to obtain data, so it is necessary for all countries to formulate their own policies to promote the recognition of smart containers and formulate data Exchange rules to enable data exchange at the national level successfully.

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