

# Research on Big Data Application in the field of shipping operation and management

Liu Zhu<sup>1</sup>, Yao Jiu-wu<sup>2</sup>

<sup>1</sup>Qingdao Ocean Shipping Mariners College, Qingdao, China, PC: 266071

<sup>2</sup>China COSCO Shipping Corporation Limited, Beijing, China, PC: 100031

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**Abstract:** In order to comprehensively master big data application in the field of operation and management of marine transportation in China and promote much deeper integration between technology and industry, this paper conducts an analysis on big data application types, generation, collection, method exploration and current existing problems, makes further study on the application of big data in the sub-fields of ship operation monitoring, shipbuilding technology improvement, port management, public shipping service, shipping e-commerce and smart ships etc, meantime, this paper puts advanced opinions concerning the further development and application of big data in the foregoing fields, for the purpose of providing referential and guiding values including for the popularization of big data application in the shipping community, expanding new application fields, enhancing mutual learning techniques, improving the effects of application, raising the efficiency and benefits of marine transportation and management and promoting the overall level of the industry.

## 1. Foreword

Human society has entered the era of information economy, the Internet economy and the digital economy, and thus Big Data has attracted more and more attention. With the rapid development of big data-driven technology, E - commerce, O2O, logistics and other areas that use it to help enterprises constantly develop new business and operation patterns. Despite its late start, shipping big data is making an accelerating progress. It is significant to analyze whole change and development trend of world economy and trade by properly using shipping big data, to explore new investment opportunities. Data is easily accessible, we just need to change our perspective, pay more attention to detail and structure. We may observe a change in the conclusion and discover the truth as it is.

## 2. The overall picture of shipping big data application

In July 2014, the Marine Technology Research Association of Japan commenced the works of "Big Data Sign". In 2012, China Shipping Database platforms was established. Shanghai International Shipping Center also launched the establishment of "shipping big data laboratory" in June 2014. DNV&GL developed the fleet performance monitoring system by using big data technology. It is a common phenomenon to use big data products to improve its decision-making and management system that includes but is not limited to the relevant parties in the shipping industry chain such as shipbuilding enterprises, shipping companies, brokers, shippers, Bankers, insurance companies and ports. However, there are only a few areas that have been used with proficiency. At the same time, a considerable part is still at the beginning stage or has not yet set foot in.

### 2.1 Types of shipping big data application

According to different purposes, the application of shipping big data can be divided into three classes. The first is the application of Live Data, such as recommend economy speed for ship managers based on the mutual calculation by using data generated from voyage schedule, voyage speed, exhaust emission and marine meteorology. The second is the application based on the

analysis of historical data, it can provide services for market forecast, route arrangement, ship building, second-hand ship transaction, chartering strategy, risk control and economic benefit analysis by calculating data from the shipping business and operation. The third is the application based on predictive analysis for future development. For example, based on the existing data, it analyzes and predicts the distribution of transportation capacity, port inventory, trade flow direction and other trends about the relevant regions in the future, as well as the early warning of delayed arrival for ships.

## **2.2 Shipping big data generation and collection**

According to the Boston Information analysis, from the perspective based on the business's ability to generate data capacity, the biggest data producer is insurance and the second is the shipping industry. Robots instead of people collect data, which is one of the collection methods of shipping. Second, the process-based business transfer from offline to online. The best way to implement the former is to rely on networking and sensor. The latter mainly relies on e-commerce.

## **2.3 Problems existing in the application of shipping big data**

At present, there are several problems in the application of big data that need to be broken through and improved step by step in the shipping industry. One is the "format" problem encountered in the process of data integration. Establishing a unified data format standard is an urgent problem to be solved in development of shipping data. The second is the problem of "open sharing" required by big data. It is necessary to establish a multi-party win-win and mutually beneficial information sharing mechanism, so that information sharers can obtain the information they need from the information platform at the same time, and establish the information sharing platform with the mechanism of "demand pull". The third is the hidden security problems of big data. The security risks of attacking big data have become a barrier to the development of big data and the target of hackers. The fourth is the lack of data analysis ability. Data analysis is the core part of shipping big data processing process. It is very difficult to achieve comprehensive integration of shipping data, efficient and flexible storage, accurate and lossless processing and quick and convenient query. And the last one is talent shortage in big data processing. It is not easy to build a team that not only understands the shipping industry, but also masters the information technology, data processing and other technologies.

## **3. Application of big data in ship operation monitoring**

At present, there are few applications of big data in ship operation monitoring, which is mainly due to) ①In terms of data collection, at present is mainly collected during sea trial by using own instruments measurement. The time and amount of data collected for such data are limited due to under specific environmental conditions, meantime, the navigation data in the operation of ships are mainly reported according to the timing mode, which is usually reported from ships to shore every 4h or 6h. Moreover, manual statistical copying is still a common phenomenon.) ②In the aspect of data transmission, the current operation of the ship information management widely used wireless transmission way and small batch data communications such as wireless telephone communications, wireless telegraph communication, international mobile satellite communication, E-mail communications, so it's also difficult to handle massive data when ship in service if adopt the long-term monitoring.

With the rapid development of information technology and communication technologies, ship instruments and equipment have gradually realized intellectualization, and navigation ship satellite positioning technology has been relatively mature, which makes it possible to measure a lot of physical data of operating ships and It is becoming more and more urgent and feasible to collect ship operation data information and utilize big data technology to monitor the performance of operating ships. ①With the help of online real-time acquisition of ship operation monitoring data

to obtain ship attitude data, such as speed, course, draft, etc. sea condition data, such as wind, waves, water temperature, etc; ship energy consumption data, such as the main and auxiliary engine operating parameters, speed and torque, rudder angle, etc; Information on the navigation, position and movement of the ship; And the working parameters of various equipment on the ship, etc., and then collect the refueling information, fresh water inventory and supply information, inbound and outbound dynamics, cargo loading, typhoon prevention and other information to form a relatively complete collection of operating ship data. ②By means of wired encryption, data is sent to the designated onshore network information platform when the ship is in shore or dock. ③In order to improve the quality of data, missing and distorted data in ship monitoring are cleaned and filtered. When data are preprocessed, monitoring data are imported into the database in a certain form.

#### **4. Big data application in the field of shipbuilding and repair**

##### **4.1 Ship energy efficiency operating index (EEOI) based on big data conversion**

By filtering the big data of the operating ships, firstly adopt the method of classification extraction, and then apply the test analysis and conversion method of ITTC or ISO on the actual ships to analyze the power and speed indicators of the operating ships, and obtain the corresponding operating index EEOI of ship energy efficiency, which serves for the management of shipping energy efficiency and also provides support for the implementation of MRV mechanism in the future.

##### **4.2 Ship type development research based on the sea condition data of the navigation area**

Make full use of the long-term monitoring data collected from sea environment, such as the wind, wave and flow, water depth, water temperature, etc., to establish sea area and route information according to the statistical data come from navigation routes, area and time, also use it as supplement for the real-time meteorological information, which can be applied to ship type development and design, route optimization and speed optimization, etc.

##### **4.3 To judge and evaluate the running status of the equipment**

Through continuous monitoring and analyzing the collection data from the vessel main equipments to verify the running status of the equipment, combined with the operating characteristics of the equipment, to get warning of equipment failure, to determine the necessary maintenance measures, etc, it provides support for daily maintenance of equipment, safety management and cost management.

#### **5. Big data application in port management**

As is well known, the big data application technology of the port abroad is relatively earlier than that in domestic, such as Europe's biggest port, Rotterdam port, equipped with large and complex system, it has developed to the port with the center of international transportation information system (INTIS), for system integration of large port information data, to organize the owner, shipper, shipping agent, freight forwarding, maritime authority, ship inspection, commodity inspection, and land transport enterprises, commerce, customs, financial services and a series of institutions in the process of logistics, to join into the system, Finally, with the help of the open environment of the Internet to serve many types of users, meantime, design convenient software to achieve automatic information processing, in order to achieve multi-party resource sharing and efficient operation.

In recent years, the domestic big data technology is gradually applied to the port business. On June 10, 2014, the ministry of transport issued the guidance on promoting port transformation and upgrading, aiming at vigorously promoting the promotion and application of new generation of information technologies such as Internet of things, cloud computing and big data in ports to

promote the construction of intelligent ports. In recent years, Shanghai port has been promoting the construction of data center and establishing cross-platform big data cloud analysis platform to realize the transformation from traditional offline data collection and analysis to automatic real-time circulation and sharing on line, so as to provide accurate and timely data and information support for leaders to make decisions. Dalian port is establishing a public information platform to meet the business needs of port supervision authorities, port and shipping logistics enterprises and shippers. On the other hand, Wuhan new port makes full use of the digital platform including and sharing by ports, ports of entry and users to realize the massive information exchange, sharing and value added across departments and regions.

## **6. Application of big data in shipping public management**

### **6.1 Intelligent dispatching of container yard**

With the real-time processing and summary of the data of the container yard in and out in the integrated area, to calculate the current number of container yard, and dynamic estimate the demand of containers in the future based on the historical model, along with the sending of instructions to intelligent allocation of the container number of each yard, therefore, it can greatly reduce the loss of enterprise operation caused by impeded information and save social resources.

### **6.2 An online search platform for ships**

The "big shipping date" has established an online search platform in 2015 , By means of innovated with methodology, summarized and sorted out liner shipping date information collected from different sources and channels, to provide the most extensive coverage, the most timely update of the shipping date, its main intelligent functions are as follows: First, real-time data can be used to find the current shipping date and ship position that are constantly updated and changed; Second, the dynamics of visibility. when inserts the search details of ship schedule into the map and displays the current position of the ship in time, users can judge whether the voyage is consistent with the expectation, which can help improve the shipping planning; Third, personalized configuration. The search platform can make recommendations and match popular ports based on users' recent search records and saved sailing schedule, so as to save search time and optimize search experience; Four, powerful analyses, which can effectively assess percentage of reliability of shipping schedules and the deviation of average shipping date for different carriers under the control of five popular ports to effectively assess the probability of on-time delivery.

## **7. Application of big data in the smart ship**

Intelligent ship is a comprehensive embodiment of the application of intelligent sensing technology, communication and navigation technology, energy efficiency control technology, intelligent status monitoring and fault diagnosis technology, distress early warning and rescue technology, route planning technology and integrated ship technology. In order to occupy a favorable position in the smart ship market, shipbuilding giants such as South Korea, Britain and China have been competing to carry out relevant researches. Hyundai heavy industries, one of the world's leading shipbuilders, has cooperated with Accenture to design smart ships that can gain a wide range of navigation information, including location, weather and ocean current data, as well as the status of the equipment and the loaded cargo with the help of sensor networks. Shanghai ship design institute takes the lead in research and designed "green dolphin", 38800 t bulk carrier, that represents the level of Chinese intelligent ship, its main superiority is reflected in the overall performance of the ship monitoring and energy efficiency monitoring, analysis and optimization, the important equipment and system operation monitoring and performance analysis, route planning based on the hydrological and meteorological information, environmental impact analysis, the optimization of navigation decision and navigation control, etc.

## 8. Summary

Shipping industry is one of the most affected by the world economic cyclical, in fact, the concept of big data has been hidden in the ups and downs, mysterious cycle, it has become an irreversible trend in which opportunities and challenges coexist, in the next five to ten years, it will be the frontier area that businesses must strive for. How can our enterprises promptly cope with it when big data comes? In the shadow of decreased market, all shipping companies need to improve their competitiveness by taking advantage of the research and development of big data.

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