8-28-2016

Study on open-packing inspection of dangerous goods container at Shanghai Port

Guohua Li

WORLD MARITIME UNIVERSITY

Dalian, China

Study on Open-packing Inspection of Dangerous Goods Container at Shanghai Port

By

Li Guohua

The People's Republic of China

A research paper submitted to the World Maritime University in partial

Fulfillment of the requirements for the award of the degree of

MASTER OF SCIENCE

(MARITIME SAFETY AND ENVIRONMENTAL MANAGEMENT)

DECLARATION

I certify that all the material in this research paper that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this research paper reflect my own personal views, and are not necessarily endorsed by the University.

Signature): ……Li Guohua……

(Date): ……2016-08-05……

Supervised by: Zheng Yunfeng

Professor

Dalian Maritime University

Assessor: …….

Co-assessor: ……**…..**

ACKNOWLEDGEMENTS

First of all, I would like to thank my tutor, Professor Zheng Yunfeng, the various aspects of this paper have been carefully guided, so that I can finally complete the graduation thesis, in this, I express my heartfelt thanks.

Secondly, I would like to thank the leadership of the Shanghai Maritime Bureau. They gave me this learning opportunity, to let me have the chance to learn related knowledge from the international well-known professors. It also lets me have the opportunity to meet so many lovely classmates.

Finally, I would like to thank my wife, who is my strong backing, because of her hard work, that I can be at ease in learning.

ABSTRACT

With the development of the world economy and international trade, the freight volume increases, the status and function of the container transportation in the national economy is more and more prominent, and the dangerous goods container transportation is also increasing year by year. But there is also a shortage in container transport, and that is because the transport of the goods has strong concealment, and dangerous goods have the characteristics, like being flammable, being explosive, corrosion, toxicity and volatility. We know that different kinds of dangerous goods to the container packing and ship stowage position requirements have different requirements, and a slight negligence will cause serious losses. In recent years, due to the error of dangerous goods declaration, omission, deliberate concealment, misrepresentation, poor packing quality caused by accidents have occurred, and some have even caused the very serious consequences, causing the loss of life and property at the same time. The disastrous consequences of the marine environment and fishery economy should not be overlooked. This has put forward higher requirements for the Marine Department of dangerous cargo container transport regulation. The open-packing inspection, as a kind of effective means for regulation of dangerous cargo container, completes the open-packing inspection of container transportation safety is very important.

KEY WORDS: open-packing inspection, dangerous goods container, fuzzy comprehensive decision, **AHP**

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LIST OF ABBREVIATIONS

MSA	Maritime Safety Administration.
CBP	Customs and Border Protection
IMDG	International Maritime Dangerous Goods
ISO	International Standardization Organization
CCC	Customs Convention on Container
CSC	International Convention for Safe Container
SOLAS	Convention on the Safety of Life at Sea
IMO	International Maritime Organization
AHP	Analysis Hierarchy Process
FCL	Full Container Load
LCL	Less than Container Load

CHAPTER ONE

INTRODUCTION

1.1 Development of Container Transportation

In 1801, Dr. Anderson James of the British people put forward the idea of container transport. In 1853, the United States railway adopted the container loading method, which was the world's first prototype of the emergence of the container transport. In 1880, the United States formally developed the first inland waterway container ship. The official use of the container was in 1890, which had a comparatively simple way of container transport in the British Railways; in 1917, container transport was tried to run the railway in the United States, (followed by ten years, Germany, France, Japan, Italy had appeared in the container transport.)? Founded in 1933 in Paris, the International Container Association, which is responsible for the development of a unified standard container. After the Second World War, which is 1952, the United States established the "military container rapid service system". In 1955, American Malcom Mclean first proposed the point that container transport must implement the sea land combined transport. In April 26, 1956, the United States (Pan-Atlantic Steamship Co) tried to run the container transport in New York to Houston Route, in October 1957, the company with the grid box container ship sailed from New York to Houston, marking the beginning of maritime container transport way. Since then, the hardware and software related to the transport of the container is getting better and better, and all relevant links closely linked and supported the construction, container transport multimodal transport to obtain rapid development, and the container transportation between the developed countries had basically realized the multimodal transport. Container transport of our country was started from the fifties of the 20th century, but international container transport started later, which was started after the

in the 1970s, and the stable development in the 1980s, in the 1990s, China's international container transportation had caused the earnest concern of the shipping field in the world.(Song, F, L, 2012, P.1-3)

In today's world, the trend of economic globalization is obvious, and the total amount of international trade continues to grow. 90% of the global scope goods rely on sea transport to complete. In recent years, with the rapid development of chemical industry, the domestic dangerous goods volume has increased year by year, and has accounted for a certain proportion of the total volume of goods transport. In several modes of transportation, the dangerous goods transportation by waterway is the biggest, and the total amount of dangerous goods transported by sea showed a significant upward trend. The classification of dangers under the rules of International Maritime Dangerous Goods extended more than 3000 kinds, which account for more than 50% of the total category of marine transport cargo. In China, according to statistics, in 2008 the import of dangerous goods reached nearly 4.8 hundred million tons, the export of dangerous goods totaling 2.5 hundred million tons, which occupies 20% of the water transport volume.

1.2 Significance of The Topic

China's mainland coastline is about 18000 kilometers long, north to the Yalu River, South to the Beilun River estuary； there are a large number of open ports on the coast. At present, many ports in China is mainly used in the container selection principle based on the experience of maritime law enforcement officers. In this paper, the target box selection system will fully take into account the various factors

affecting the selection of the target box, and through mathematical methods to effectively combine all kinds of influencing factors, form a scientific and effective system of selecting the box. Finally electing dangerous cargo container that is the most needed to be checked through the open-packing inspection.

1.2.1 To Improve The Efficiency of Maritime Regulation

High quality and efficiency of the box selection method or the principle is stronger, and the probability is higher than finding the illegal dangerous goods container, which will greatly reduce the workload of maritime law enforcement officers, saving manpower and material resources in the Maritime Safety Administration.

1.2.2 To Reduce The Maritime Accidents of Container

High quality and efficiency of the box selection method or the principle can help maritime law enforcement officers to investigate and deal with more dangerous target boxes, reduce the transportation risk of dangerous cargo container to the maximum extent, and reduce the occurrence of the relevant maritime accidents, to really guarantee the safety of the ship and personnel and to protect the fragile marine environment.

1.2.3 Referential Significance

It has reference value to other Maritime Safety Administration in dangerous cargo container supervision; on the other hand, it will also ease the plight of the management of dangerous goods in our country to some extent.

1.3 Status Quo At Home and Abroad

1.3.1 Foreign Research Status

In inspection work to the ship carrying dangerous goods container, the main content is the choice of the target box, and the relevant scholars and researchers at home and abroad have done a lot of research on the selection of dangerous goods containers. Because of the complexity and variety of dangerous goods transportation, there is no uniform evaluation system and method for the selection of the target box of dangerous goods containers. (Orphan, Muenchau, Gormley, Richardson, 2005, P. 723-732)

In 2006 by the United Kingdom Royal insurance indemnity association and Felixstowe dangerous goods safety management center jointly organized an expert seminars, held in Seoul, Hongkong, Singapore, Shanghai and Taipei respectively, which mainly discusses: what are the rules of the International Maritime Dangerous Goods (IMDG), the causes of accidents in the transportation of dangerous goods, aimed at, through training, improving employees in shipping industry of container transport of dangerous goods sense of crisis prevention and crisis management ability.

Singapore uses system of fast neutron analysis of cargo inspection to inspect dangerous goods container; the system uses a nanosecond pulsed neutron beam to inquire about the contents of a small volume element of a cargo container or truck. The syntax-colored is the three-dimensional position of a suspected contraband, such as drugs or explosives. Neutrons interact with the elements of each vowel, and Y - ray characteristic elements are collected in the detector array. Element signal and its

ratio to the unique signature of drugs and other contraband, from the time of arrival of the Y ray, this vowel is determined at the position of the truck. (Brown, Coates, Kuo, 1997)

Previously, the Japanese maritime sector mainly used radio imaging for container inspection. With the passage of time, there have been many unique advantages of a variety of query system. At present, they are developing a "out of the box with the active detection technology solutions, and carrying out technical research. (Jones, 2003)

In 2004, the United States has begun to explore the three main types of border inspection: immigration, customs and animal and plant health, and transferred the inspection rights to the U.S. Department of homeland security, which marked a shift in policy of the major. While having an important responsibility of commercial, economic, health, humanitarian, and Immigration, it is the top priority of the time to ensure the security of the border. Homeland security officials decided to further integrate inspection duties, which mean that the Bureau of Customs and Border Protection (CBP) inspectors are essentially interchangeable, and to be responsible for all major checks.(Wasem, 2004)

In 2008, Kumar, S. and Verruso, J (2008, P. 26-41) proposed a design decision support framework for container transportation and handling systems based on the failure mode effect and criticality analysis, which was successfully used in the United States port container. They put forward a simple model of risk assessment system to prevent dangerous cargo container transport into the United States port, and put forward the frame of design application, which involves the shipment from China to the United States container station. The software not only shows how to

effectively help reduce the risk of failure, while focuses on how to affect the operation of the deployment of the supply chain management, thus saving costs.

In 2010, Archibong. J. Ituth studied all the technology of inspection by the United States customs agency to the entry containers into the United States, and analyzed the development of the use, effects and selection techniques between 2009 and 2002, including gamma ray, X - ray imaging and radiation detection, and the current screening technology research. The results support the CBP inspector to detect dangerous cargo containers and reduce the international supply chain disruption.

In 1994 the United States Department of transportation allocated funds set up the coast guard's "National Container Inspection Program pressure". In 2013, the coast guard analyses the container inspection data from this system between 2003 to 2012, to determine the trend and focus of domestic container inspection, and introduced the relevant provisions of “COMDTINST M16616.11C”, which request the inspection departments of the various regions to determine the amount of inspection of the year in this area , according to the container handling capacity of the local area in the last year, whether there is a joint inspection operation with CBP, whether there is a joint inspection operation with the national cargo bureau, and whether there is a joint inspection operation in the relevant departments of the port. For the selection of the box selection, the provisions are the following requirements: first, the inspection of dangerous box and common case should be equal; second, spot checks should also take into account the import and export boxes; third, inspection officer should consider the effective historical data, including violations of statistics, to determine the priority of the inspection of the container.

1.3.2 Domestic Research Situation

Compared with the developed countries, our country is late to study on the open-packing inspection of container. With the in-depth study of domestic scholars, China's dangerous cargo container open-packing inspection research and development will be faster and better.

In 2004, in accordance with the relevant national laws and regulations, combined with the actual situation in Shanghai, Chen Bowei (2004, P. 25-27) studied the dangerous goods container quality, concealment, false behavior, and put forward three focus, which are the open package inspection, record management and monitoring and inspection respectively, to strengthen the supervision and management of dangerous goods container, so as to ensure the safety of the container transport. Qian Wenlong (2007, P. 39-41) discussed the practice of open-packing inspection of dangerous goods container, aiming at the problems found in the open-packing inspection, and put forward the suggestion on the safety supervision and management of the container transportation of dangerous goods. Zhou Lian (2010, P.310-313) and Zhang Xingqiang (2008, P. 43-45) in view of the current ships carrying status of dangerous goods, focused on the analysis of the dangerous goods container concealed, false phenomenon exists, and proposed countermeasures and suggestions to reduce the dangerous cargo container concealed, false phenomenon. Xu Hanhua (2009, P.246-257) summarized the safety problems in the container transport of dangerous goods into three categories: the safety of goods, the safety of the container and the problems in the management of dangerous goods containers, then combined with the transport process of dangerous goods container and the management regulations of our country on the container transport of dangerous goods. From two aspects of the transport related party and regulatory authorities to do in-depth analysis, among them, focuses on the analysis of the three factors of the shipper, the carrier and the maritime regulation, which have a significant impact on

the safe transport of dangerous goods. Lin Jun (2008) developed the software of container inspection system in 2008, not only to solves the problem of low efficiency of traditional manual opening, but also to strengthen the customs anti smuggling and security demand. Qiu Huazan (2010, P. 48-51) learned from experience in artificial selection of dangerous goods container, established evaluation index system of dangerous cargo container inspection, and used the neural network method to establish the nonlinear target box evaluation model and carries on the example verification, to improve the accuracy of ships carrying dangerous goods container unpacking inspection and inspection efficiency.

Shenzhen maritime safety administration has a "container ship carrying dangerous goods safety management system", (If directory from IMDG and the domestic dangerous goods into the system,)? The system will be automatically compared with the information obtained from the customs, thus narrowing the scope of inspection.

Integrating the above, in foreign countries, the United States combined with its own dangerous goods container management system, giving full consideration to the possibility of the joint action of coast guard, the national cargo bureau, customs and border protection mouth, port mouth, and formulated the "national the container the inspections of the program", which has great significance to China's container inspection. In China, some maritime authorities have developed some information management platform, and the Ministry of transportation issued relevant guidance and promoted the implementation of the ships carrying dangerous goods declaration in recent years, but considering the influencing factors is relatively single.

1.4 **Typical Accident**

In March 21, 2006, South Korea's container named "modern fortune" had burning and exploding in the sea off the coast of Yemen, about 60 miles south of the coast, a total of 2249 containers were burned, according to the estimation; the direct loss of the accident was more than $100 million, which is a rare serious fire in the history of world container shipping, shocking the entire international shipping industry. After the investigation, the specific cause of the accident is concealed carrying 1.1 types of explosives, fireworks, calcium hypochlorite and other dangerous goods.

In August 25, 2010, the container ship named "Pulis CMA CGM" who belongs to the German owner, when container loaded and unloaded, its sling screw lock has not been solved, and the container has exploded with the light of the fire. The box body is protruding outward, and the top of the box had 1 square meters of iron burst. After the investigation, the specific cause of the accident is the shipper concealed gas lighter and lighter gas.

In May 28, 2003, burning accident occurred in the container ship "Mount Huading" suddenly in the way to Guangzhou Whampoa port, the goods in the cabin called "iron oxide" burned, and finally, the accident led to the "Mount Huading" sank. According to the investigation, the actual loading of goods for dangerous goods was "insurance powder", its scientific name sodium dithionite, which belongs to the 4.2 category of dangerous goods in China. The cause of the fire accident is illegal transportation insurance powder; in the process of packing and transportation, the box was damaged, which led to Inhale moisture, and eventually, spontaneous combustion caused a fire accident.

In September 8, 2004, the "Oriental Rotterdam" was on the way from Shanghai to Czech, a container loaded on board, while cargo in the box leaked, which leads to

two crews being poisoned. In order to thoroughly clean the residue in the cabin, the ship had to turn all the containers in the contaminated cabin to the dock, which caused additional costs, such as labor, loading and unloading, and delayed the sailing date. After open-package inspection, one of the goods in the box, toluidine, was found, which belongs to Class 6 as IMDG. It is because in the consignment process, Shippers concealed the truth from higher authorities, who did not explain the hazardous nature of hazardous chemicals to the carrier; under the circumstances that the ship-owner did not know the fact, this box was improper stowage above the heating fuel tank, which leaded to the occurrence of leakage accident.

1.5 Definition and Structure of Container

1.5.1 Definition of Container

Container, from the literal meaning of its English can be understood as the holder, but not all the holders can be called the container. About the definition of container, different countries, regions and organizations in the world, their expressions are also different. In many countries, including China, have adopted the International Standardization Organization (ISO) to define the container. In order to ensure the safety of container loading and unloading, stacking and transportation, in the definition of the container, ISO put forward the basic condition that the container should have a kind of cargo transportation. In addition to the provisions of containers, terminology and test methods etc, ISO also made some provisions on the structure, performance and other technical features of the container, which is the difference between the container and the outer packing of the goods and other containers; in addition to loading the goods, it also needs to meet many special requirements. That is to say, only the "container" with these conditions can be regarded as a container.

These basic conditions are as follows：

(1) Total or partial closure, which constitutes a cargo compartment;

(2) durable, strong enough to be used repeatedly;

(3) A device for handling and transportation, especially for transport from a facelift to another means of conveyance;

(4) To facilitate the filling and emptying of the goods;

(5) The content of the product is 1 cubic meters or more than 1 cubic meters. (http://baike.baidu.com/view/50438.htm)

At present, the United States, China, Japan, France and other countries have a comprehensive reference to the definition of International Standardization Organization (ISO). In addition to the definition of ISO, CCC (Customs Convention on Container) and CSC (International Convention for Safe Containers) also have the definition of container, but the content is basically similar to ISO.

To be brief, container is a large container with certain strength, stiffness and specifications for turnover use. When container transport cargo is used, it can be loaded directly at the shipper's warehouse, then transported to the consignee's warehouse. In the process of transportation, if replacing the car or the ship, there is no need to take the goods out of the box. In addition, it should be noted that the definition of the container is not included in the vehicle and the general packaging. (http://baike.baidu.com/view/3251719.htm.)

1.5.2 Structure of Container

The structure of the container varies according to the type of box, but its main structures have Corner Fitting, Corner Post, Top Side Rail, Bottom Side Rail, Top End Transverse Member, Bottom End Transverse Member, Side Panel, Side Wall, Door, Roof Sheet, Floor, Door Header, Door Sill, Roof Bows, Floor Bearers or Cross Member, Side Posts, End Posts, Fork Pockets, Corner Structures, Base Structures and Base Frame, Gooseneck Tunnel. (http://baike.baidu.com/view/11794343.htm.)

1.5.3 Characteristics and Advantages of Container Transportation

1.5.3.1 An Efficient Form of Transport

The high efficiency of container transport is reflected in the following aspects:

1. It has a very fast speed for loading and unloading;
2. It has a short time to stay in port, and has high working efficiency;
3. It improves utilization of equipment and the port facilities;
4. The goods are transported at a fast speed, and the cash flow of the goods is fast.

1.5.3.2 A High Quality Transport Form

Container has solid and sealing characteristic, so the goods are not easy to be stolen in transit, and it also can prevent the impact of bad weather and the environment on the goods inside the box effectively, and therefore, the cargo damage accident greatly reduced. At the same time, the packaging of the goods itself can be simplified than the traditional form, which saves the cost of packaging. What's more, it has greatly reduced the damage and loss in many operations. In addition, what the mentioned above can improve the speed and so on. All of these indicate that the container transportation is a kind of high quality movement.

1.5.3.3 highly Dense Capital Industry

Container transportation is based on the container transportation system, which is a special system, including efficient terminals, marine transport ships, inland collection and drainage system and a large number of containers, etc. These facilities, transport

lines and containers are required for a large number of investment funds. In the cost structure of container transport, the proportion of fixed costs in the total cost is much higher than the traditional transport. It should be pointed out that the high cost of container transport in a certain extent offset the benefits brought about by the low cost of the above, the cost of working fast, low labor costs; especially in developing countries, the direct cost of container transport is not low. But if you look at the total cost and social benefits, due to speeding up the operation of speed, reducing the loss and damage, to save packaging costs and improve the capacity and the scale benefit, container transportation is still a kind of comparatively economical transportation mode.

CHAPTER TWO

An Overview of The Transport of Dangerous Goods Container

2.1 Definition of Dangerous Goods

2.1.1 The Definition of Dangerous Goods In International Conventions, Guidelines and Rules

The "dangerous goods shipment" in the seventh chapter of SOALS convention, describes the various forms of transport of dangerous goods in detail, which covers transportation of packaging and transportation of dangerous goods in bulk, liquid chemicals in bulk and liquefied gases in bulk. It is consistent with IMDG CODE for the classification of dangerous goods. According to the definition of IMDG CODE, dangerous goods mean it contains materials and articles. The nature of goods listed in IMDG CODE includes goods with characteristics such as combustion, explosion, corrosion, toxicity, radiation, and environmental pollution.

2.1.2 The Definition of Dangerous Goods By Domestic Laws and Regulations

“Rules for the carriage of dangerous goods by water "is a important technological basis of our state's hazardous cargoes, which follows the definition and classification of dangerous goods in "Classification and code of dangerous goods", which defined the dangerous goods as substances and articles with the explosive, flammable, toxic, infection, corrosive, radioactive and other characteristics. In the transportation, storage, production, operation, use and disposal, it is easy to cause personal injury, property damage and environmental pollution and the need for special protection. At

present, "People's Republic of China shall ship safety supervision and administration of carriage of dangerous goods" is the main basis for the supervision of dangerous goods in our country. It defined the dangerous goods as substances and articles with explosive, flammable, poisonous, corrosive, radioactive, pollution of characteristics. In the process of carriage by vessel, it is easy to cause the personal injury, loss of property or environmental pollution and needs special protection.

There are many kinds of dangerous goods in sea transportation, which have their different properties, and they have a different degree of danger, and most of them have a variety of dangers. In order to facilitate safe transportation and management, it is necessary to carry out scientific classification of dangerous goods. In “Waterway dangerous goods regulations” made by our country and “international maritime dangerous goods transport regulations" made by IMO, according to the main danger of dangerous goods and transport conditions, dangerous goods are divided into 9 categories(As shown in Table 1.1).

Tab.1 Dangerous Cargoes Class

Class	category
Class 1	Explosives
Class 2	Gas: compressed, liquefied and dissolved under pressure
Class 3	Flammable liquids
Class 4	Inflammable solids substances liable to spontaneous combustion and substances emitting flammable gases when wet
Class 5	Oxidizing substances and organic peroxides
Class 6	Poisons and infectious substances
Class 7	Radioactive substances
Class 8	Corrosives

Class 9	Miscellaneous dangerous substances

2.2 Characteristics of Transport of Dangerous Goods Container

Because of the unique characteristics of high efficiency, convenience and sealing, transporting dangerous goods by container has many advantages:

(1).It can alleviate the boxcar tensions, reduce logistics intermediate links, greatly improve the economic benefit and is easy to carry out "door to door" transportation;

(2).It is conducive to the realization of one-stop service goods for "checked", "pay", "secured";

(3).It can reduce the cost of transportation and imports and exports of foreign trade;

(4).It can improve efficiency of transport, and reduce the hazards of dangerous goods in transit process;

(5).Sealed transportation of dangerous goods, can reduce the harm of dangerous goods to the ship, the port and the surrounding environment, and improve the safety factor of the goods transportation.

There are many advantages in the transport of dangerous goods container, as well as a lot of disadvantages of this mode of transport. In today's situation, where the business and quality standards of employees being dangerous goods container cargo transport are below quality, regulatory enforcers is in lack, and the legal and regulatory system is not sound, there are a lot of potential risks in the container transport of dangerous goods. And over the years, as the container yard facilities do not have the conditions for dangerous cargo container transport, and following the traditional management mode, in addition to which, personnel quality and technical level is low, there is a serious security risk of using container transport of dangerous goods. Closed transportation makes it difficult for us to figure out what goods are in

the box and what is the condition of the goods. It is more difficult to examine whether the loading of the goods complies with the requirements of the packing. Maritime administration departments could not do open-packing inspection to all the containers, which leads to the shipper for their own interests to conceal false box of dangerous goods information, and the ship, crew and dock are in great danger. Once an accident occurs, it will cause serious pollution to the marine environment.

2.3 Safety of Container Transport of Dangerous Goods

As the container in the transportation, packaging and box are integrity, and identification is correct and clear; at the same time, it also satisfies the stowage and lashing requirements, so it has high security. However, it needs lead seal after packing. If the packing is damaged in the goods transportation, which will lead to a lot of safety problems in the container transport of dangerous goods, which will lead to various accidents. There are three main problems in the safety of the container transport of dangerous goods:

(1). the security problem of the goods;

(2). the security problem of the container;

(3). the security problem of the dangerous goods container management.

2.3.1 The Security Problem of The Goods

Due to the risk of the goods themselves, before packing, they should be packed in accordance with the relevant rules. In general, as long as the packaging of good is accordance with IMDG and other relevant rules, then the possibility of the problem is small. If the dangerous goods are not packed, or the packing is not in accordance with the provisions, then there is a potential problem in the course of transportation.

In addition, dangerous goods are also likely to be mixed with the ordinary in the transport, which should also cause enough attention.

2.3.2 The Security Problem of The Container

Container as a container for transporting dangerous goods, empty containers are often loaded with industrial waste, which caused serious pollution of the container, therefore, before shipment of dangerous goods, the container should be cleaned thoroughly, so as to eliminate the harm and ensure the safe transportation of the dangerous goods. The container itself has a strong and good sealing, which can withstand a certain pressure, thereby isolating the dangerous goods. Once the box is damaged or seal is lax, resulting in water or the case of dangerous goods leakage, for spontaneous combustion, corrosive or toxic dangerous goods, they will cause serious pollution accidents.

2.3.3 The Security Problem of The Dangerous Goods Container Management

Improper stowage and false declaration are the most prominent in the management of dangerous goods containers. The stowage should be strictly in accordance with the specific requirements of the IMDG-Code to determine the appropriate location. In addition, dangerous cargo liner inside, lashing insecure, illegible, even with the actual logo not matching the packing are also frequently encountered problems in the management of container.

CHAPTER THREE

Analysis On The Safety of Dangerous Goods In Container Transportation

3.1 The Dangerous Cargo Transport Process

Container cargo packing way is divided into Full Container Load (FCL) and Less than Contained Load (LCL). Container transport of dangerous goods mainly adopts FCL, usually the delivery way for door to door, which means the carrier accept the whole case goods in the shipper's warehouse or factory, and then ship the whole case to the consignee's warehouse or factory. Under the FCL, the shipper first booking the carrier, after carrier confirmation, the shipper picks up empty container to container freight station. Site Supervisor supervises packing process of dangerous goods, and issues a "dangerous cargo container packing certificate". Dangerous goods declarer did Declaration by the certificate; after that, the carrier received the container and shipped it to the container freight station. After the arrival of the ship, the carrier will be transported to the container terminal, and then shipped. The personnel on board the vessel did the safety management of dangerous cargo container. Some time before arriving in the port of destination, the carrier would submit "dangerous cargo container packing certificate", dangerous goods declaration and other documents to the MSA at the port of destination. After MSA agreeing, the ship can enter the port to discharge.

3.2 Supervision Basis of Container Transport of Dangerous Goods

China's management of the transport of dangerous goods container, is mainly based on the seventh chapter of SOLAS Convention, Annex III of MARPOL73/78

Convention, IMDG CODE, Maritime Code of the People's Republic of China, Regulation on the Safety Administration of Dangerous Chemicals, the rules of domestic waterway container transportation, the ship carrying dangerous goods supervision and management rules, provisions on the supervision and management of dangerous goods packaging container shipment, the provisions on the declaration of foreign trade of carriage of dangerous goods by ship, and other normative documents.

3.3 The Problem of Container Inspector

Container inspector has a significant effect on the container transport of dangerous goods safety guarantee. However, according to the provisions of the "container carrying dangerous goods inspector training and assessment methods", container inspector must be employees of the container packing unit, because the door to door transport development, and the right to engage in foreign trade gradually liberalized, in practice most container packing work place from the original in the container freight station is transferred to the manufacturer's warehouse, so in most cases, the container inspector, packing unit belong to the same unit, it is very difficult to ensure that they will not in the interests of the unit((reducing freight costs, reducing procedures, reducing costs) to conceal the real situation of the goods are forced to, thereby affecting the validity of the declaration of dangerous cargo containers.

3.4 The Problem of Qualification of The Shipper

At present, China has no legislation to stipulate the legal qualification of the maritime dangerous goods shipper; only in 2002 the State Council promulgated the "dangerous chemicals safety management regulations" seventh article stipulates that

"The State shall adopt a licensing system for the management of dangerous chemicals sales, without permission, no unit or individual shall not engage in sales of dangerous chemicals." In shipping practice, the consignors of dangerous goods are mainly some dangerous chemicals production and sales enterprises, chemical plants, oil companies, who occupies a large proportion. They are familiar with the nature of dangerous goods, good credit, with performance of dangerous goods shipper's obligations in good condition. While some smaller, occasionally involved in dangerous goods shippers, who lack the sense of danger and the necessary knowledge of dangerous goods, they often have concealed and false declaration, disrupting the market of consignors of dangerous goods, but also a serious impact on the dangerous goods normal sea transportation. At the same time, the shipper economic strength is very weak, generally not having more than one modern container ship assets. Therefore, once there is the accident, punishment and claims is difficult to obtain compensation.

3.5 The Factor of Carrier

3.5.1 The Qualification Problem of Dangerous Goods Carrier

Carriers of dangerous goods carry the goods, which has brought great dangerous to ship, cargo, human life and health, the marine environment; if a bit inadvertent, it will cause the ship crash. In order to ensure the safety of maritime transport, all countries are required for dangerous goods carrier to meet certain conditions and requirements, which mean they can safe transport of dangerous goods, and they have the skill and ability to handle dangerous goods accident properly when it occurs. In this way, they can be allowed to enter the shipping market of dangerous goods.

3.5.2 The Problem of Negligence of The Carrier

At present, as the carrier of the ship company, as long as the customer (shipper) provides the description of packages and goods, not requiring to provide the correct shipping name, which is the carrier can make customer satisfy, but can't cooperate with national maritime administration to declare the work of dangerous goods, this makes her take greater risks; at the same time, it also violates the maritime law of China.

3.5.3 Other Factors of Related Transport Parties.

In the process of container transport of dangerous goods, Container freight station operator, container terminal operator, the consignee have some influence on the safety of transport. For example, for the container freight station operator, he was entrusted by the carrier to the shipper to lend container. The container must meet the "1972 International Convention for safe containers" (CSC), and pass the inspection conducted by the relevant inspection department. When the loading of dangerous goods container transport to the station, commissioned by the carrier, he must stowage, segregation according to the requirements of IMDG-CODE, and he should put up obvious warning signs in the area surrounding the container packing, isolate from other box area with obstacles, including daily monitoring of temperature and humidity of the project.

CHAPTER FOUR

Open-Packing Inspection of Dangerous Goods At Shanghai Port

4.1 Brief Introduction of Shanghai Port

Shanghai port is located in the Yangtze River Delta; it is in the middle of China's coastline, which has 18000 kilometers; it is located in the Yangtze River Estuary and at the intersection of the Yangtze River Transportation Corridor and North South Corridor at sea. Not only it is China's main coastal hub port, but also is an important port of China's participation in international economic cycle. In all of the foreign trade goods in Shanghai City, 99% of them import and export by Shanghai port. Foreign trade throughput completed each year accounted for about 20% of the nation's major coastal port. As a world famous port, since 2010, Shanghai port cargo and container throughput ranked first in the world. In 2015, Shanghai port container throughput reached 35 million and 200 thousand TEUs. It is expected that Shanghai port total cargo throughput would reach about 600 million tons in 2020; according to the estimation, the container is about 37 million TEUs, and the weight of container is about 366 million tons. (http://baike.baidu.com/view/127274.htm.)

Tab.2 Port Throughput of Shanghai Port In November 2015

	port	unit	The cumulative since the beginning of the year	Year-on-year growth（%）
Shanghai	Shanghai inland port	ten thousand ton		-100
Cargo throughput	Shanghai	ten thousand ton	59435	-3.2
Foreign trade cargo throughput	Shanghai	ten thousand ton	34524	-1.7
Cargo throughput	Shanghai	ten thousand	6270	-19.7

	inland port	ton		
Container throughput	Shanghai	ten thousand ton	3347.13	3.3

In 2015, the number of the ship carrying dangerous goods to import and export Shanghai port ship reached 7’0151 times. The volume of dangerous goods was a total of 53 million 772 thousand tons. A total of containers of dangerous goods were 953120 TEUs.

(1) Dangerous goods shipping times compared to the same period in 2014 and 2013 increased by 2.44% and 5.75% respectively;

(2) Dangerous cargo throughput year-on-year in 2014 and 2013 respectively increased by 13.07% and 11.77%;

(3) Dangerous cargo container throughput fell 1.97% compared to 2014, increased by 10.9% compared with 2013.

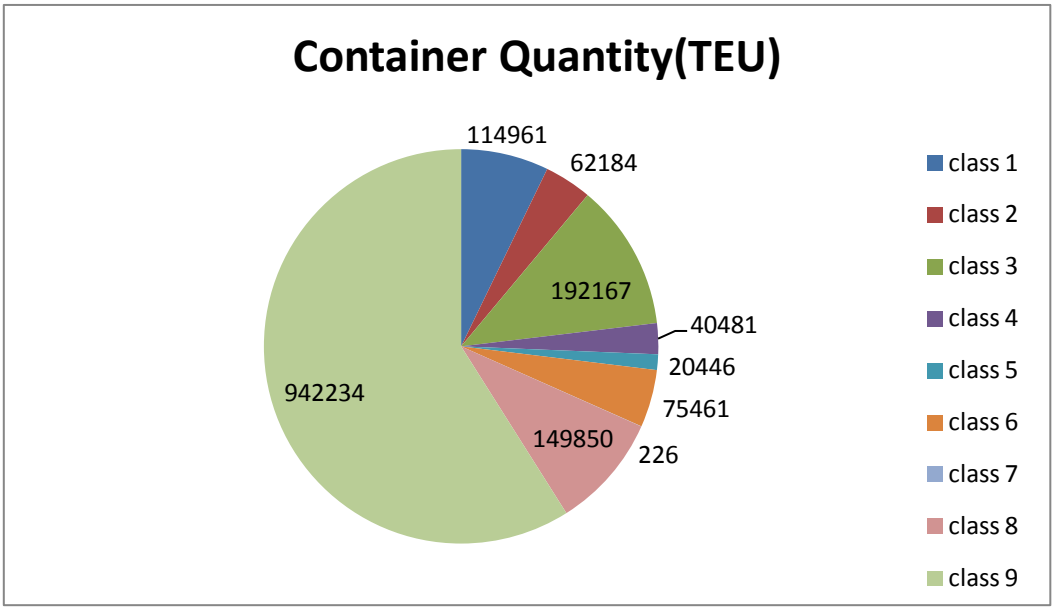
Tab.3 The Statistical Data of Shanghai In 2015

direction of traffic flow	times		Volume		container quantity	
	times	proportion（%）	Volume（ton）	proportion（%）	container quantity（TEU）	proportion（%）
arrival	11105	22.8	12904693	58.6	301115	36.1
departure	12541	25.8	5686825	25.8	330415	39.1
transfer	25051	51.4	3433253	15.6	215081	24.8
transit	7796	16	15173825	68.9	242497	31.3
total	48697		22024770		942234	

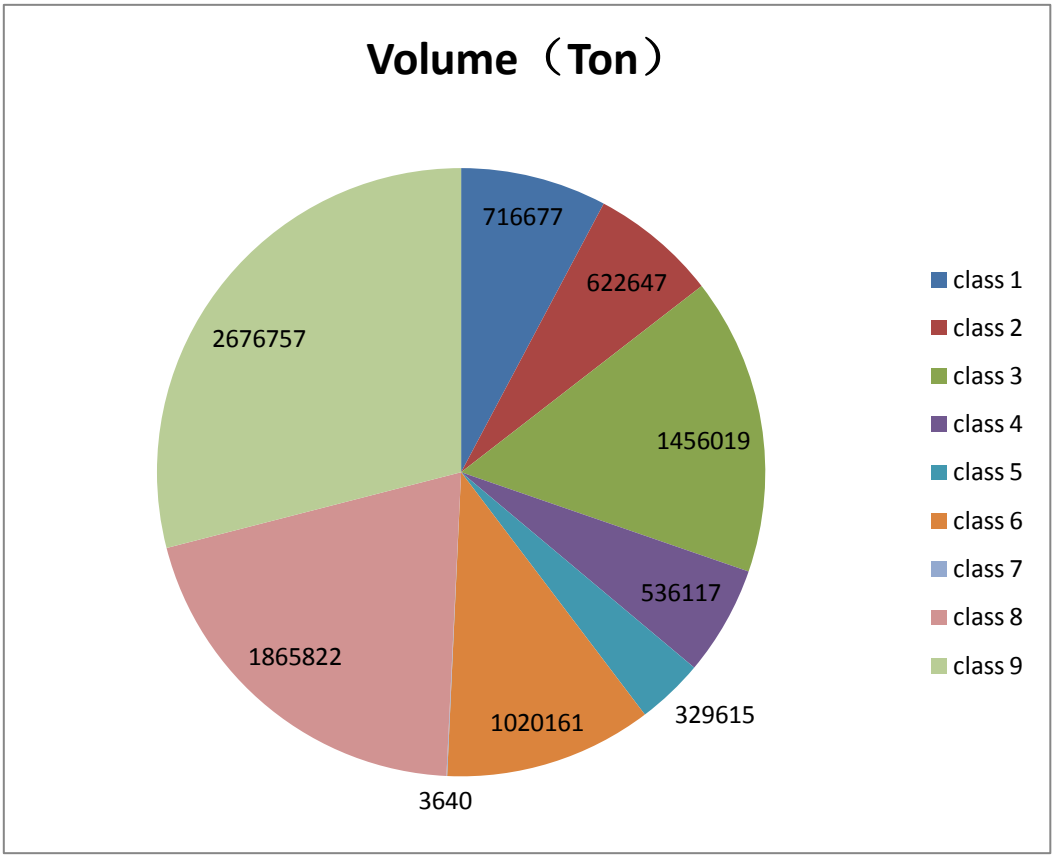
Tab.4 Foreign Trade Packing Dangerous Goods

Class	Volume （Ton）	container quantity（TEU）
Class 1	**716677**	**114961**
Class 2	**622647**	**62184**
Class 3	**1456019**	**192167**
Class 4	**536117**	**40481**
Class 5	**329615**	**20446**
Class 6	**1020161**	**75641**
Class 7	**3640**	**226**
Class 8	**1865822**	**149850**
Class 9	**2676757**	**286278**
total	**9227455**	**942234**

Tab.5 Container Quantity



Tab.6 Volume



From November 2014 to October 2015, the number of doing the open-packing inspection was 341 times by all the basic units of Shanghai MSA, and the container number is 610 cases, seized 124 illegal cases of cases to false declaration.

Tab.7 Statistical Table For The Inspection of The Marine Department At The Basic Level

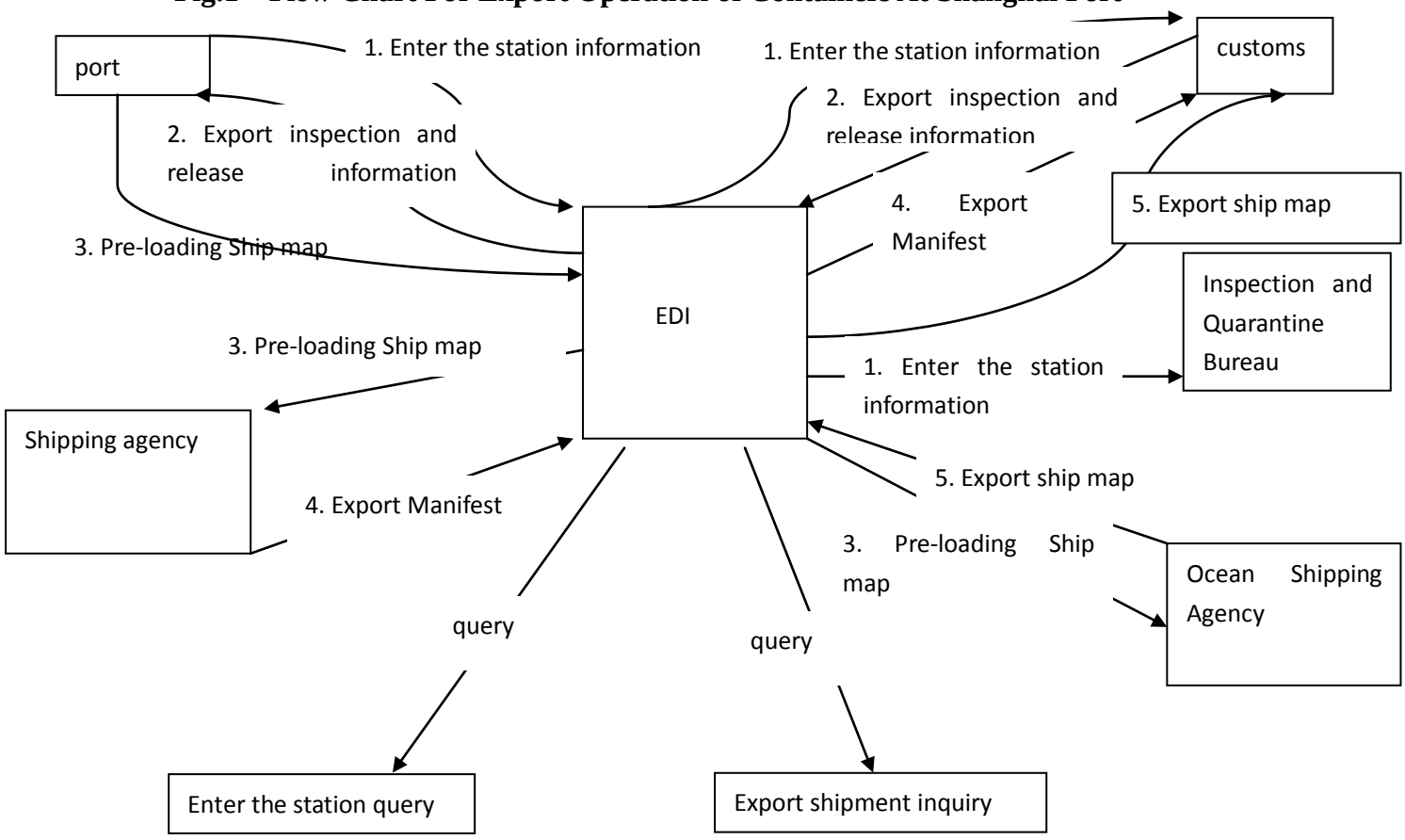
tributary station	The times of open-packing inspection			The number of open-packing inspection			The number of illegal cases to false declaration			The number of container to false declaration		
	2015	2014	cent year-on-year	2015	2014	cent year-on-year	2015	2014	cent year-on-year	2015	2014	cent year-on-year
Pudong	107	126	↓15%	164	200	↓18%	58	70	↓17%	101	115	↓12%
Yangshan	137	150	↓9%	220	256	↓14%	52	49	↑6%	105	92	↑14%
Wusong	62	54	↑15%	140	126	↑11%	12	10	↑20%	13	13	--
Baoshan	12	12	--	20	16	↑25%	2	2	--	4	3	↑33%
Yangpu	23	31	↓26%	66	58	↑14%	0	0	--	0	0	--
Total	341	373	↓9%	610	656	↓7%	124	131	↓5%	223	223	--

4.2 Flow For Export Operation of Containers At Shanghai Port

4.2.1 Flow For Export Operation of Containers At Shanghai Port

With the increase of container throughput of Shanghai port, container import and export and transfer rate are also growing fast. Standard operating procedures can shorten the customs clearance time, reduce the pressure port and staff for, which is conducive to open-packing inspection of the port; it also can avoid omission or duplication operation. At present, the process of Shanghai port container port operation is shown in Figure 1.

Fig.1 Flow Chart For Export Operation of Containers At Shanghai Port



(Chen wei, 2010, P. 25-27)

The operation flow of container in the port is divided into 5 steps:

(1) After export container entering the port, port sends the information to the customs;

(2) After the owner doing export declaration, customs send the release information to port;

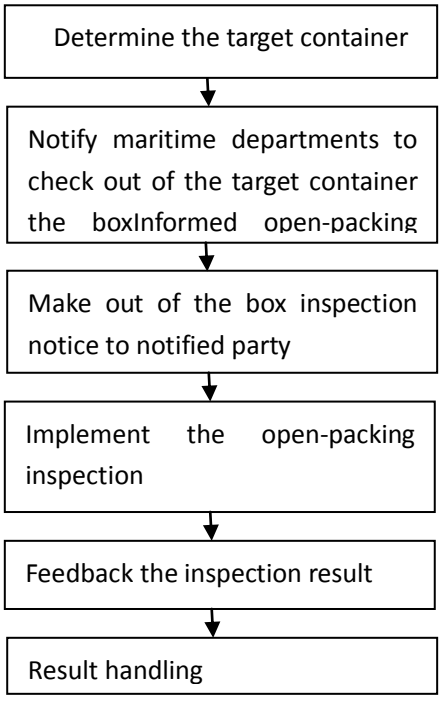
(3) Port sends the pre-loading Ship map to Shipping agency and Ocean Shipping Agency;

(4) Shipping agency sends Export Manifest to customs as the pre-loading Ship map;

(5) Ocean Shipping Agency sends Export Manifest to customs as the pre-loading Ship map.

At present, Shanghai port of dangerous goods container open-packing inspection work, it is mainly in accordance with the requirements of the Shanghai Maritime Bureau of ships carrying dangerous goods container unpacking inspection notice. The open-packing inspection process is divided into three parts: determine a goal box, the scene out of the box, the investigation and handling of work. The Flow of The open-packing inspection is shown in Fig 2.

Fig.2 Flow Chart For The Open-packing Inspection Containers At Shanghai Port



4.3 The Main Contents of The Open-packing Inspection

4.3.1 The Main Contents of The Open-packing Inspection

(1). To check and deal with the external situation of the following dangerous goods container before open-packing inspection:

A. Container safety qualification card;

B. To check Dangerous goods in container is overweight or not;

C. Status of container;

D. The condition of container sign and marking.

(2). After the opening, the following should be checked:

A. Whether the actual packing content is consistent with the declaration form or not;

B. Whether the package is in conformity with the requirements of IMDG and the domestic regulations and in conformity with the declaration form;

C. Whether the packing is in accordance with the provisions of the display of dangerous goods signs and markings;

D. Whether dangerous goods package stacking is correct or not;

E. Whether the packing of dangerous goods package, reinforcement is reasonable or not;

F. Is there a non compatible material inside the container;

G. Whether the loading of different goods meets the requirements of isolation;

H. If the dangerous goods in the box are to take special protective measures, whether or not it is done.

After the inspection, maritime law enforcement personnel should timely record the inspection, and fill out the "the people's Republic of China Shanghai Maritime Bureau ship load container open-packing inspection record form", and at last, the

relevant personnel should sign to confirm the relevant circumstances. If you need to declare a member of the scoring, indicating the score, season, and sign by the parties to confirm. After the end of false and concealed dangerous goods open-packing inspection, marine department should also make the scene "check record", which is a detailed record of inspection, inspection results correct description, and confirmed by the participation of the relevant personnel to sign.

4.3.2 The Principle of Choosing The Container

We should choose to check the container before open-packing inspection, and the principle of selection of the Shanghai port is mainly as follows:

(1) The four cases will be checked, those are the first time for Packing clerk to declare the container; the first time for dangerous goods loaded in port; the first time the container declared by the entity that is engaged in the declaration of dangerous goods, the container declared by declaration clerk who is the first time doing the declaration;

(2) Focus on bottled liquid containers, boxes and other inflammable and explosive goods;

(3) If the dangerous cargo container is under the following conditions, we should focus on the implementation of inspection;

a. Having a broken or leaking phenomenon;

b. Reported to have quality problems;

c. Reported cases are not in conformity with the actual declaration of goods;

d. Assembled or converted;

e. Declaration of poor integrity of the units to declare;

f. Packing inspector with bad faith.

(4) Government affairs center and the basic marine department determine the target

through the report, independent use of "information management system" retrieval access to suspected concealed false container information of dangerous goods;

(5) When daily patrol , the marine department can check the container that is found to have breakage, pollution, leakage or leakage phenomenon.

4.4 The Reason of Dangerous Cargo Container False Concealed

Due to the container of the closed form, people can't directly see what kind of goods and what kind of situation in the container, the dangerous goods container concealed false provide conditions, which is to provide the conditions of dangerous cargo container false concealed. Some owners think the risk of the packaging of dangerous goods is smaller than the bulk, driven by economic interests, so in the process of transportation, loading and unloading, they will deliberately conceal the dangerous goods as ordinary cargo container transport, not complying with the relevant international, domestic regulations and technical specifications, which put the ship and crew in danger, so that the risk of water transport is further increased. The author thinks that the causes of the phenomenon of false concealed dangerous goods containers are as follows: (Chen, H, J. 2007, P. 23-24)

(1) The lack of knowledge of dangerous goods. The shippers lack knowledge on the transport of dangerous goods. They also do not know the consignment is dangerous. In addition, they do not know special provisions on the transport of dangerous goods by sea, causing a concealed false problem.

(2) The negligence. Manufacturers did not account for the characteristics of the relevant dangerous goods. Most of the container is multimodal transport; before the delivery of water transport, it has passed the road, rail transport. If the first class shipper did not explain clearly, and the carrier did not check the relevant information, it is very easy for the carrier not to know dangerous goods in the container.

(3) Driven by interests. Dangerous goods freight is generally higher than ordinary goods about 15%. As the shipper of dangerous goods, especially the annual freight, this part of the cost is great. For example, under normal circumstances, the freight of a 20 foot general cargo container from Shanghai shipped to Europe is generally $1500; if is dangerous goods container, it would increase by 30% of freight, which is enough to lure illegal operation of some dangerous goods shipper.

(4) Smuggled goods. At present, some countries put some dangerous goods included in the prohibited or limited operation. In this case, the buyer that need such kind of goods or the seller of such goods can only sign the sales contract in private, by changing the name of the goods, providing false information or not providing dangerous goods transport documents to escape the supervision of the competent authorities.

(5) The sense of responsibility is not strong. Container loading point or container terminal lack experienced dangerous goods management personnel. Packing inspectors do not seriously fulfill their duties, as well as the responsibility of the crew on the container ship is not strong, which causes the packaging, logos, stowage and segregation of container carrying dangerous goods not meeting the specified requirements, or even illegal phenomenon of container ships overload transportation etc.

(6) Some ports with small container handling capacity are not carrying out dangerous cargo container loading and unloading operations, they do not have the dangerous goods loading and unloading qualifications. If the shipper truthfully declares dangerous goods, I am afraid it is difficult to import and export through the port. In order to enlarge the throughput and stable container supply of goods, they generally do not take the initiative to the maritime authorities to report that undeclared dangerous goods container.(Huang, Z, Q, 2011, P. 43-45)

(7) The current container management mechanism provides objective conditions for undeclared dangerous goods container. Whether the port or the carrier shall have the right to carry out of the container, that is, the shipper of the goods says what it is in the container. In fact, concealing dangerous goods is the responsibility of the shipper, and the carrier has no intention to conceal ; however, the carriers are not familiar with the relevant laws and regulations, and suspicious of the shipper of goods has not caused a high degree of attention: in addition, they do not report suspected container to the maritime authorities in time. This situation is even more prominent in the case of the economic downturn, in order to stabilize the supply of goods; sometimes the carriers know the container is concealed false dangerous goods container, but they do not report to the maritime authorities.

(8) Some goods identification costs are higher, such as Pb-PbO_2 battery, an identification to do down needs about 6000 yuan; in order to reduce the cost, the shipper would conceal the property of goods.(Huang, W, J, 2008, P. 46-48)

CHAPTER FIVE

Target Selection Method Based On Fuzzy Comprehensive Evaluation Decision Model

5.1 Fuzzy Comprehensive Decision Model

5.1.1 Definition of Fuzzy Comprehensive Decision

In practical problems, we always compare different things according to their advantages and disadvantages. If it is only a particular attribute of things to judge, this is still very easy to do; however, in actual production activities, people usually have to sort the same things with multiple attributes, and some of the attributes are also very strong fuzziness, so "good" or "bad"can't be simply used to make a coincidence, but the use of a different degree of fuzzy language to wake up the assessment. At this point, it is necessary to take into account all aspects. Fuzzy comprehensive evaluation is an application of fuzzy set method; all decisions are made on the various factors involved, according to the establishment of the evaluation index system, and finally a general decision is made. (Wang, Q, Q, 2006, P. 26-31), (Li, X, 2007, P. 30-32)

5.1.2 Classification of Fuzzy Comprehensive Decision Method

Fuzzy comprehensive decision making can be divided into single layer and multi-layer comprehensive decision making. In actual production activities, people often encounter the low level of a single factor can be determined by the lower level of multiple factors, which is a multi-level problem. In solving this kind of problem,

we first make a comprehensive evaluation of the sub problems from the low level, and then make a comprehensive evaluation on the whole. According to the actual situation, this paper uses the multi-level model of the comprehensive evaluation model. (Xiang, F, 2007, 132-134)

5.2 The Establishment of Factor Set And Evaluation Set

5.2.1 Factor Set

Setting the first evaluation index, named the target layer is $U=\{U_1, U_2,..... U_n\}$, constitute the first set of evaluation factors, named U={ship factors U_1, cargo factors U_2, human factors U_3}

Setting the second level of evaluation index, is named the criterion layer with U_{if} (i=1,2,... F=1,2; m,... N). At this point, according to the attributes of each element in the U, that can be divided into a number of sub factors set. Such as U_1 = (route; operator of a ship; ship name), U_2= (name of goods; packing the goods; goods form), U_3= (collection, the consignor of the goods; freight forwarding and booking; packing; declaration).

5.2.2 Evaluation Set

Evaluation set is a set of evaluation results of the evaluation object, which is expressed as: $V=\{V_1; V_2;... V_n\}$. Among the elements, V_j (J=1,2,... M) is likely to make the evaluation results. The purpose of fuzzy comprehensive evaluation is to obtain an optimal evaluation result from the evaluation set V. In general, the evaluation set is defined as 5 levels, described as $V=\{V_1; V_2;... V_5\}$, and the corresponding rating reviews and the quantized value is V={ very low risk target box,

low risk target box, general risk target box, high risk target box, high risk target box}={0-0.5,0.5-1.5,1.5-2.5,2.5-4,4-5}.

5.3 Determination of Weight of Evaluation Index Based On Analytic Hierarchy Process(AHP)

5.3.1 The Choice to Determine The Weight Method

At present, Analytic Hierarchy Process is the most widely used method to empower the evaluation index, and the technology is more mature. Compared with the relative importance of each factor in the evaluation index system through the relevant fields of experts, managers and professional technical personnel, it would complete the comprehensive judgment of the target box. In this paper, the AHP method is used to determine the weight of the box selection index in the container cargo transportation.

5.3.2 The Basic Steps of AHP

5.3.2.1 Constructing Hierarchical Structure Model

Induction according to the characteristics of a system, a new level of evaluation factors with common characteristics will be formed, and the layer by layer will be progressive until a single highest layer is formed. Thus, a hierarchical structure model consisting of the highest, middle layer and bottom layer is formed, which is mainly divided into the target layer, the criterion layer and the factor layer.(Adam, S. Markowski, M. Sam Mannan, Agata Bigoszewska, 2009, P,695-702)

5.3.2.2 Establish Judgment Matrix

It is assumed that C_x in C hierarchy element is related to P_1, P_2, P_n, the judgment matrix is formed shown in Tab 5.1, and the judgment matrix is usually expressed as B.

Tab.8 Judgment Matrix

C_x	P_1	P_2	…	P_n
P_1	b_{11}	b_{12}	…	b_{1n}
P_2	b_{21}	b_{22}	…	b_{2n}
…	…	…	…	…
P_n	b_{n1}	b_{n2}	…	b_{nn}

AHP commonly indicates any two factors between the rating value with 1-9 scale, as shown in table 5.2.

Tab.9 The Relative Importance Index Proportion Scale

scale	definition	illustration
1	Equally important	The two elements are of the same importance.
3	Slightly important	In comparison with the two elements, one element is more important than the other.
5	Obviously important	In comparison with the two elements, one element is more important than the other.
7	Much more important	Comparison of the two elements, the dominant position of an element has been shown.
9	Extremely important	Comparison of the two elements, the dominant position of an element is absolutely important.

When the number of indicators can be used to determine the index, we can compare

the underlying factors from the bottom of the system. P1, P2,..., Pn factors and C were compared to represent between Importance of two indicators of factors, using the judgment matrix B to express the result of the judgment.

$$B=\begin{matrix} b11 & b12 & ... & b1n \\ b21 & b22 & ... & b2n \\ ... & ... & ... & ... \\ bn1 & bn2 & ... & bnn \end{matrix}$$

Judgment matrix B has the following characteristics:

(1) $b_{11}=1$

(2) $b_{ij}=1/ b_{ji}$

(3) $b_{ij=} b_{ik} / b_{jk}$

If we can meet the above 3 characteristics, we can ensure that the judgment matrix has complete consistency.

5.3.2.3 Importance Ranking

According to the judgment matrix, we can calculate feature vector W of corresponding characteristic roots that are maximum λmax.

B•W= λmax•W

Normalized feature vector, the process is the importance of ranking, that is, the weight distribution.

5.3.2.4 Consistency Checking

Consistency checking is carried out by reference to the consistency index of the judgment matrix, which is represented by CI (CI =λmax-n/n-1).

The smaller is the consistency index CI value, the closer the matrix is in complete

agreement. The greater is the number of N matrix, the greater is the deviation of the matrix. When the number of judgment matrix is more, the average random consistency index is RI. The RI value for the n=l-9 order matrix is shown in the following table:

Tab.10 The Value of RI

N	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45

1 order and 2 order judgment matrices have complete consistency. CR indicates random consistency ratio, which is the ratio of Consistency index CI and the same order average random consistency index RI.

CR=CI/RI

When the CR is less than 0.1, the judgment matrix is satisfied.

5.3.3 Determination of Weight of Evaluation Index

On the basis of the research on the port and container transportation, and based on the summary of the consultation and investigation of experts, managers and professional technicians, the judgment matrix is established.

5.3.3.1 Weight To Determine To The Target Box Selection Evaluation Index

According to Tab 5.1 "target box selection evaluation index system", we construct the judgment matrix.

Tab.11

Judgment matrix	Ship factors	Cargo factors	Human factor
Ship factors	1	1/4	1/6

Cargo factors	4	1	1/2
Human factor	6	2	1

We can draw a conclusion.

w=[0.1315,0.4779,0.8685], λmax =3.0092

Then the weight of the index system is [0.0890, 0.3234, 0.5876]

Finally, the consistency test is carried out, CI=0.0046, CR=0.0079<0.10, which indicates that the target box selection evaluation index judgment matrix has satisfactory consistency. Therefore the weighting matrix is w=[0.0890, the 0.3234 0.5876]. Similarly, you can calculate the weight of the other levels.

Tab.12 The Evaluation Matrix and Weight of Ship

Judgment Matrix	Route	Ship operator	The name of the ship	Weight
Route	1	1/3	1/2	0.1634
Ship operator	3	1	2	0.5396
The name of the ship	2	1/2	1	0.2970
λmax =0.30092, CR<0.1 meet Consistency checking				

Tab.13 The Evaluation Matrix and Weight of Cargo Factor

Judgment Matrix	Name of goods	Packing of goods	Form of goods	Weight
Name of goods	1	4	2	0.5714
Packing of goods	1/4	1	1/2	0.1429
Form of goods	1/2	2	1	0.2857
λmax =3, CR<0.1 meeting Consistency checking				

Tab.14 The Evaluation Matrix and Weight of Human Factor

Judgment Matrix	consignee or consignor	Freight forwarding and booking party	Packing clerk	Declaration clerk	Weight
Consignee or consignor	1	2	1/6	1/4	0.0995
Freight forwarding and booking party	1/2	1	1/3	1/8	0.0693
Packing clerk	6	3	1	1/2	0.3291
Declaration clerk	4	8	2	1	0.5021
λmax =4.2072, CR<0.1 meeting Consistency checking					

5.4 Determination of Membership Degree of Evaluation Index

Because the risk degree of the evaluation index is fuzzy, and the degree of danger is in a fuzzy distribution between the adjacent risk levels, the reviewers cannot point out the danger level. To realize the quantization of this kind of fuzzy state, the membership function is used to transform the fuzzy state. (An, M, 2007, P. 45-46)

When determining the membership function, this paper draws on relevant research,

establishing the corresponding relationship between the specific evaluation criteria of evaluation indicators and the level of risk, thus constructs membership fuzzy subset of the index factors to achieve a good transition of boundary fuzzy. This paper determines the evaluation criteria and evaluation set $V=\{v_{l,}v_2\ldots,v_n\}$. The evaluation grade is divided into 5 levels, which are extremely low risk target box, low risk target box, general risk target box, high risk target box and very high risk target box, and the corresponding fuzzy numbers are 1, 2, 3, 4 and 5 respectively, so fuzzy evaluation set can be expressed as $V=\{v_l, v_2, v_3, v_4, v_5\}=\{$ extremely low risk goal box, low risk goal box, general risk goal box, higher risk target box, very high risk target box $\}=\{1, 2, 3, 4, 5\}$.

According to the evaluation criteria, we get the relationship between the specific evaluation criteria of each index and the set of evaluation based on the experience of the experts and the judgment criterion to Construct membership function, then calculating the membership degree of each index value, composing evaluation matrix $R_i= (r_{i1}, r_{i2},..., r_{im})$. Through data processing, we get the index evaluation matrix. The membership function F1 (x), F2 (x), F3 (x), F4 (x), F5 (x) respectively, are shown as follows:

$$F1(x)=\begin{cases} 1 & x \le 0 \\ 1-x & 0 \le x \le 1 \\ 0 & x>1 \end{cases}$$

$$F2(x)=\begin{cases} x & 0 \le x < 1 \\ \frac{5-2x}{3} & 1 \le x \le \frac{5}{2} \\ 0 & x \le 0 \text{ 或 } x > \frac{5}{2} \end{cases}$$

$$F3(x)=\begin{cases}\frac{8-2x}{3} & \frac{5}{2}\le x<4\\ \frac{2-2x}{3} & 1\le x<\frac{5}{2}\\ 0 & x<1 \text{ 或 } x\ge 4\end{cases}$$

$$F4(x)=\begin{cases}\frac{2x-5}{3} & \frac{5}{2}\le x<4\\ 5-x & 4\le x<5\\ 0 & x<\frac{5}{2} \text{ 或 } x\ge 5\end{cases}$$

$$F5(x)=\begin{cases}0 & x<4\\ x-4 & 4\le x<5\\ 1 & x\ge 5\end{cases}$$

In the process of establishing evaluation set, based on the research of port and container transportation, through consultation and investigation to a number of experts, professional and technical personnel and management, the data mainly is summed up.(Cheng C, 2015)

Tab.15 The Stranded of Evaluation Factors

	extremely low risk (0-1)	low risk (1-2)	general risk (2-3)	higher risk(3-4)	very high risk（4-5）
Route	other	Taiwan	South America	Southeast Asia	Africa
Ship operator	state-owned enterprise has no false concealed	foreign enterprise has no false concealed	private enterprise has no false concealed	Concealed false for one time	Concealed false for 2 times and above
The name	no false	no false	no false	Concealed	Concealed

of the ship	concealed for long-term	concealed when transferred or altered.	concealed when multiple transferred or altered.	false for one time	false for 2 times and above
Name of goods	other	Ordinary goods	key word	The name been used to conceal	Goods containing materials or supplies
Packing of goods	other	box	woven bag	bottle	bucket
Form of goods	other	massive solid	powdered solid	colloidal liquid	gas
Consignee or consignor	other	Farming and Livestock Farming Enterprise	chemical plant	Metallurgy, chemical manufacturing enterprises	Plastic rubber textile printing and dyeing enterprise
Freight forwarding and booking party	Class A reputation and no false concealed	Class B reputation and no false concealed	Class C reputation and no false concealed	Concealed false for one time	Concealed false for 2 times and above
Packing clerk	Length of service	Length of service 2-5	Length of service less	Concealed false for one	Concealed false for 2

	more than 6 years and no false concealed	years and no false concealed	than 1 years and no false concealed	time	times and above
Declaration clerk	Length of service more than 6 years and no false concealed	Length of service 2-5 years and no false concealed	Length of service less than 1 years and no false concealed	Concealed false for one time	Concealed false for 2 times and above

5.5 Multi Level Fuzzy Comprehensive Evaluation Model

Fuzzy comprehensive evaluation based on fuzzy mathematics, using the principle of fuzzy mathematics, which is an analysis method to analysis and evaluation of the "fuzzy" and use the combination of qualitative and quantitative. When the system is more complex, it needs to consider the factors are often more, and each factor has different levels of structure; at this time, the use of multi-level fuzzy comprehensive evaluation model, should carry out a comprehensive evaluation to each layer of a class, and then judge a higher level of all kinds according to the results. (Joao, J, Flavio, M, 2012, P. 33-47).

5.5.1 Initial Evaluation

To the membership degree of each evaluation set V, Any indicator U_i is a fuzzy subset of V. recorded as $R(U)=(r_{i1}\, r_{i2} \ldots\, r_{in})$, we can get the following:

$$B_i = A_i \cdot R_i = (W_1, W_2 \ldots W_m) \cdot \begin{matrix} r11 & r12 & r1n \\ r21 & r22 & r2n \\ \ldots & \ldots & \ldots \\ rn1 & rn2 & rnn \end{matrix} \quad (i=1, 2, \ldots, n)$$

A_i is the weight, R_i is the corresponding membership degree.

5.5.2 The Second and Third Level Evaluation

$$B = \begin{matrix} B1 \\ B2 \\ \ldots \\ B3 \end{matrix} = \begin{matrix} A1 \cdot R1 \\ A2 \cdot R2 \\ \ldots \\ An \cdot Rn \end{matrix}$$

We introduce the Weighted Mean Method, then can judge the level of the risk of the box.

$$V = \frac{\sum_{j=i}^{n} bjvj}{\sum_{j=i}^{n} bj}$$

5.6 Instance Verification

Through the typical case below, we can validate the usefulness of the evaluation model.

5.6.1 Evaluation Factors

Route: Africa; ship operator: a shipping company in Europe; ship's name: HUASHANG; consignor: TOPKEY; consignee name: SHANGHAITECH TECOLOGY; declare goods name: medical raw material; form of goods: packaging bottle; freight and booking Name: Shanghai Xinan shipping company subordinate agency; morphology of goods: solid.

5.6.2 Factor Analysis

The shipping company mainly engaged in the container transportation routes from Shanghai to Africa, the historical data show that the ship belongs to the company (a once concealed 2 times)?. Declaration of the name of the goods containing chemical raw material, is a material containing materials or supplies. The result shows that there are three concealed dangerous goods in the container, they are epoxy resin (3, UN1866); paints (3 class; UM263); benzoperoxide (5.2 class, UN3101); glycol butyl ether (class 6.1, UN2801) respectively.

5.6.3 Validation Results

5.6.3.1 Initial Evaluation

Evaluation of ship factors

$$B_1=A_1 \cdot R_1=(W_1,W_2 \ldots W_m) \cdot \begin{matrix} r11 & r12 & r1n \\ r21 & r22 & r2n \\ \ldots & \ldots & \ldots \\ rn1 & rn2 & rnn \end{matrix}$$

$$= \begin{matrix} 0.1634 & 0.5396 & 0.2970 \end{matrix} \cdot \begin{matrix} 0 & 0 & 0 & 0.4 & 0.6 \\ 0 & 0 & 0 & 0.8 & 0.2 \\ 0 & 0.4667 & 0.5333 & 0 & 0 \end{matrix} =$$

$$\begin{matrix} 0 & 0.1386 & 0.0952 & 0 & 0 \end{matrix}$$

Evaluation of goods factors

$$B_2=A_2 \cdot R_2=(W_1,W_2 \ldots W_m) \cdot \begin{matrix} r11 & r12 & r1n \\ r21 & r22 & r2n \\ \ldots & \ldots & \ldots \\ rn1 & rn2 & rnn \end{matrix}$$

$$= \begin{matrix} 0.5714 & 0.1429 & 0.2857 \end{matrix} \cdot \begin{matrix} 0.1 & 0.9 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.2 & 0.8 \\ 0 & 0 & 0.3333 & 0.6667 & 0 \end{matrix} =$$

0.05714 0.5143 0.0952 0.2191 0.1143

Evaluation of Human factors

$$B_3 = A_3 \cdot R_3 = (W_1, W_2 \ldots W_m) \cdot \begin{matrix} r11 & r12 & r1n \\ r21 & r22 & r2n \\ \ldots & \ldots & \ldots \\ rn1 & rn2 & rnn \end{matrix}$$

$$= \begin{matrix} 0.0995 & 0.0693 & 0.3291 & 0.5021 \end{matrix} \cdot \begin{matrix} 0 & 0 & 0.8 & 0.2 & 0 \\ 0 & 0 & 0 & 0.4 & 0.6 \\ 0 & 0 & 0 & 0.3 & 0.7 \\ 0 & 0 & 0 & 0.4 & 0.6 \end{matrix} =$$

0 0 0.0796 0.3472 0.5732

5.6.3.2 The Second Level Evaluation

$$B = A \cdot R = \begin{matrix} 0.0890 & 0.3234 & 0.5876 \end{matrix} \cdot \begin{matrix} 0 & 0.1386 & 0.1584 & 0.4970 & 0.2060 \\ 0.0514 & 0.5143 & 0.0952 & 0.2191 & 0.1143 \\ 0 & 0 & 0.0796 & 0.3472 & 0.5732 \end{matrix}$$

= 0.0185 0.1787 0.0917 0.3191 0.3921

We introduce the Weighted Mean Method

$$V = \frac{\sum_{j=i}^{n} bjvj}{\sum_{j=i}^{n} bj} = \begin{matrix} 0.0185 & 0.1787 & 0.0917 & 0.3191 & 0.3921 \end{matrix} \cdot \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{matrix}$$

/0.0185+0.1787+0.0917+0=3.8875

The result indicates the container is a higher risk of target case, and it also is in good agreement with the result of open-packing inspection.

CHAPTER SIX

SUMMARY AND CONCLUSIONS

The safety of the container transportation of dangerous goods is not only directly related to the economic benefit of the ship, but also related to the environmental safety of the ship, the crew, the port and the surrounding waters. According to the actual situation of the container transport of dangerous goods in Shanghai port and the relevant standards and regulations, on the basis of investigation and analysis on the situation of container ship transportation in Shanghai port, in this paper, the risk factors of container transport of dangerous goods were identified and analyzed, and the emphasis is on the analysis of the relationship between ship, cargo and human factors, and then establishing evaluation index system of dangerous goods container selection container and Fuzzy comprehensive evaluation model of dangerous cargo container; at last, an example is given. The results show that the fuzzy comprehensive evaluation model can be used to achieve the target box selection, which provides a new way to solve the target inspection of dangerous goods container, and put forward some suggestions and measures to reduce the phenomenon of false declaration management. The evaluation model of this paper can not only be used in Shanghai port, but also can be used in other maritime bureau. It provides a strong basis for the establishment of the unified selection system of dangerous goods container; to a certain extent, it can alleviate dilemma of China's dangerous goods container opening management.

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